An Evaluation of Mercury Concentrations in Fish Sampled From Streams, Lakes and Reservoirs in Utah for Years 2004-2006

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Prepared by

Utah Department of Health
Bureau of Epidemiology
Environmental Epidemiology Program

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Background and Statement of Issues

The 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation report for Utah (U.S.DI 2003) estimates that approximately 517,000 people, ages 16 or older, fish in the state of Utah. The report also estimates 152,000 residents aged 6-15 years old fish in Utah. Recent public concern has been expressed about potential health risks associated with mercury levels in Utah fish.

Previous sampling of fish has resulted in the issuing of fish consumption advisories on three water bodies in Utah that include: Green River in Desolation Canyon, Mill Creek in Grand County and Gunlock Reservoir in Washington County.

- Based on an average mercury concentration of 0.47 mg/kg in Largemouth Bass, a consumption advisory was issued for largemouth bass from Gunlock Reservoir, recommending a limit of 2 eight ounce meals per month for adults and 1 four ounce meal per month for women who may become pregnant, pregnant women, nursing mothers, and young children (Scholl 2005a).

- Based on an average mercury concentration of 0.51 mg/kg in Channel Catfish, a consumption limit advisory recommending a limit of 2 eight-ounce meals per month for adults and 1 four-ounce meal per month for women who may become pregnant, pregnant women, nursing mothers, and young children were issued for Channel Catfish from Desolation Canyon (Scholl 2005b).

- Based on an average mercury concentration of 0.33 mg/kg in Brown Trout, adults can safely eat 3 eight ounce meals per month, and pregnant women, women that may become pregnant or are breast feeding and young children can eat 1 four ounce meal per month of Brown Trout from Mill Creek near Moab, Utah (Scholl 2006).

In response to ongoing concerns, the Utah Department of Health (UDOH), Environmental Epidemiology Program (EEP) conducted a review of fish sampling data for mercury from fish sampled from Utah water bodies by the Utah Division of Wildlife Resources and Division of Water Quality covering the period of 2004 through 2006, and the potential public health risk associated with mercury contaminated fish in Utah. The Utah Department of Environmental Quality (UDEQ) analyzed fish collected from 139 different sites during this period. Sampling sites are shown in Appendix A, Figure 1.

Statistical Analysis

Type I error refers to the situation in which the null hypothesis is rejected when in fact it is true. The probability of making a type I error is equal to the P-value, and is represented by the Greek letter α (alpha). For statistical analysis of the fish sampling data for this report, an alpha level of 0.10 was used ($p = 0.10$). A P-value of 0.10 would indicate that the likelihood of erroneously rejecting the null hypothesis is 10 percent or there is a 10% chance that the samples mean mercury concentration was not greater than 0.30 mg/kg when we said it was. The second kind of

error that can be made during a hypothesis test is an acceptance error, also known as a Type II error. Type II error refers to a mistaken failure to reject the null hypothesis when the alternative hypothesis is true and there is a real difference between the two groups. The probability of making a Type II error is represented by the Greek letter β (Beta). The power of a project is defined as the probability of rejecting the null hypothesis and concluding that there is a statistically significant difference between the mean mercury concentration in fish sampled at a site and the UDOH level of concern of 0.30 mg/kg if one truly exists. The power is calculated by 1-β.

In the context of this report, the Type I error is concluding that the mean mercury concentration in the fish sample exceeds the UDOH's level of concern of 0.30 mg/kg when in fact it does not. With a Type I error, the UDOH would conclude that there is a need to issue a fish advisory and proceed to issue one, unnecessarily. The Type II error is concluding that the mean mercury concentration in the fish sample does not exceed UDOH's level of concern when in fact it does. The UDOH decides that the mean mercury concentration is not at a level that would endanger the public health, so the fish advisory is not issued. A Type II error in this case will put the public at risk without their knowledge. The Type I error is controlled by setting the level of significance to a small value, and the Type II error is controlled by increasing the power of the test. One way to increase the power of a test is to raise the significance level α (alpha). Correspondingly, β becomes small and the power 1-β increases. Both error types can be controlled simultaneously by increasing the sample sizes. The larger our sample the less likely we are to commit an error of either type. In the case of this report, in order to error on the side of protecting public health, to increase the power of rejecting the null hypothesis when it is false, a P-value of 0.10 was chosen as the level of significance.

The t-test was used to compare the fish sample mercury concentrations at a particular site to the UDOH level of concern of 0.30 mg/kg. SAS statistical software was used to run the statistical analysis.

The *null hypothesis* tested was H_0: $\mu \leq 0.30$ mg/kg (The average mercury concentration in the fish sample at a site is equal to or less than UDOH's level of concern of 0.30 mg/kg).

The *alternative hypothesis* for a one-sided test is: H_a: $\mu > 0.30$ mg/kg (The average mercury concentration is greater than the UDOH's level of concern of 0.30 mg/kg).

Results

Mercury Concentrations

Individual fish samples (skinless fillets) were analyzed for mercury concentration. All mercury concentrations are reported as a wet weight concentration in milligrams of mercury per kg fish tissue (mg/kg). The Utah Department of Health (UDOH) has adopted the EPA screening value for mercury in fish of 0.30 mg/kg as the level of concern or action level for methylmercury concentrations in fish (EPA 2001).

Mercury concentrations in fish that are less than or equal to the UDOH level of concern are unlikely to result in adverse health effects when people eat these fish. At concentrations greater than 0.30 mg/kg, adverse health effects are possible. The level of concern is based on consumption rates for a recreational fisher. If a person consumes more fish than a recreational fisher, a lower action level would be appropriate. If a person consumes less fish than a recreational fisher, a higher action level would be appropriate.

Following are the results of the fish sampling and analyses by county:

Beaver County

Brown Trout were collected from Beaver River, Inat Creek and Lake Creek (above Three Creeks Reservoir) in 2004. Three fish were sampled from each site. The mean mercury concentrations for fish sampled from each site were below the UDOH level of concern of 0.30 mg/kg. One of the three fish collected from Lake Creek was 0.345 mg/kg, above 0.30 mg/kg. The mean mercury concentrations were 0.142, 0.064 and 0.246 mg/kg respectively.

In 2004, three Rainbow Trout were collected from the South Fork of North Creek. In 2005, five Rainbow Trout were collected from Minersville Reservoir. None of these fish were above the UDOH level of concern. The mean mercury concentration in these fish was 0.053 and 0.242 mg/kg, respectively. A summary of the mercury concentration in fish sampled in Beaver County is presented in Appendix B, Table 1.

Cache County

Seven water bodies were sampled in Cache County: Blacksmith River, Cub River, Davenport Creek, High Creek, Logan River, Porcupine Reservoir, and Hyrum Reservoir. Fish collected included Brown Trout, Rainbow Trout, Bullhead, Common Carp, and Cutthroat Trout. Mercury concentrations ranged from 0.011 mg/kg to 0.431 mg/kg. The UDOH level of concern is 0.30 mg/kg.

The only water body in Cache County with fish mercury concentrations above 0.30 mg/kg was Porcupine Reservoir. Three of four Brown trout collected from Porcupine Reservoir had mercury concentration greater than 0.30 mg/kg with a mean mercury concentration of 0.349 mg/kg and a range of 0.255 to 0.431 mg/kg. One Rainbow Trout was sampled from Porcupine Reservoir, with a mercury concentration of 0.366 mg/kg.

A summary of the mercury concentration in fish sampled in Cache County is presented in Appendix B, Table 2.

Carbon County

Fish were collected from Fish Creek, Price River, Rock Creek and Scofield Reservoir in Carbon County. Species collected included Brown Trout, Tiger Trout, Cutthroat Trout and Rainbow Trout. The range of mercury concentrations was 0.028 mg/kg to a high of 0.430 mg/kg.

Only one fish, a Brown Trout from Fish Creek at 0.430 mg/kg, was above the 0.30 mg/kg level of concern. The mean concentration of all the five samples from Fish Creek was 0.209 mg/kg with a range of 0.125 to 0.430 mg/kg.

A summary of the mercury concentration in fish sampled in Carbon County is presented in Appendix B, Table 3.

Daggett County

Five Brook Trout and three Rainbow Trout were collected from Beaver Creek and Farmington Creek, respectively. The mercury concentrations ranged from 0.080 mg/kg to 0.212 mg/kg. None of the values were above the UDOH level of concern of 0.30 mg/kg.

A summary of the mercury concentration in fish sampled in Carbon County is presented in Appendix B, Table 4.

Duchesne County

Eight water bodies were sampled in Duchesne County. These included Duchesne River, Red Creek, Rock Creek, Starvation Reservoir, Strawberry River, Uinta River, Lake Fork River, and Yellowstone River. Mercury concentrations ranged from 0.023 to a high of 0.735 mg/kg.

Mean mercury concentrations in Brown Trout from Red Creek and Rock Creek were greater than the UDOH level of concern of 0.30 mg/kg. The mean value for Brown trout in Red Creek was 0.347 with a range of 0.117 to 0.611 mg/kg. The mean value for Brown Trout from Rock Creek was 0.380 with a range of 0.081 to 0.735 mg/kg. However, the mean mercury concentrations in Red Creek and Rock Creek were not statistically greater than the UDOH level of concern of 0.30 mg/kg.

Of the ten Walleye collected from Starvation Reservoir, three were greater than 0.30 mg/kg. The mean concentration of mercury in Walleye collected from Starvation Reservoir was 0.213 mg/kg with a range of 0.114 to 0.404 mg/kg.

One of five Brown Trout collected from Strawberry River was above 0.30 mg/kg. The mean concentration in Brown Trout from Strawberry River was 0.220, with a range of 0.123 mg/kg to a high of 0.439 mg/kg.

Four Rainbow Trout were collected from Uinta River, with a mean mercury concentration of 0.023 mg/kg, and a range of 0.020 - 0.028 mg/kg. Two Brook Trout were sampled from Uinta River with concentrations of 0.077 mg/kg and 0.144 mg/kg with mean concentration of 0.111 mg/kg.

Three Brook Trout were collected from Lake Creek. Mercury concentrations ranged from 0.032 mg/kg to 0.063 mg/kg, with a mean concentration of 0.045 mg/kg. One Cutthroat Trout sampled from Lake Creek had a mercury concentration of 0.035 mg/kg.

One Cutthroat Trout and two Brook Trout were sampled from Yellowstone River. The mercury level in the Cutthroat Trout was 0.143 mg/kg. Mercury levels in the Brook Trout were 0.121 and 0.126 mg/kg, with a mean concentration of 0.123 mg/kg.

A summary of the mercury concentration in fish sampled in Duchesne County is presented in Appendix B, Table 5.

Emery County

Six Rainbow Trout and four Brown Trout were sampled from Huntington Lake. Mercury concentrations in these fish ranged from 0.022 mg/kg to 0.140 mg/kg.

Three Cutthroat Trout were collected from Joes Valley Reservoir, with a mean concentration of 0.207 mg/kg and a range of 0.173 to 0.235 mg/kg. The concentrations of mercury in these fish were below the 0.30 mg/kg level of concern.

Seven Splake Trout collected from Joes Valley Reservoir had a mean mercury concentration of 0.824 mg/kg and a range of 0.105 mg/kg to 1.862 mg/kg. The mean concentration of mercury in these fish was well above the UDOH level of concern of 0.30 mg/kg. **The mean mercury concentration in the Splake Trout was statistically significantly ($p = 0.065$) greater than 0.30 mg/kg, and warrants a consumption advisory.**

A map of the sample location of the Splake Trout in Emery County is presented in Appendix A, Figure 2. A summary of the mercury concentration in fish sampled in Emery County is presented in Appendix B, Table 6.

Garfield County

Sixteen water bodies were sampled in Garfield County and included Asay Creek, Bear Creek, Butler Creek, Calf Creek, Deer Creek, East Fork Boulder Creek, Lake Creek, Mamie Creek, Mammoth Creek, North Creek, Panguitch Lake, Pine Creek, Sand Creek, Antimony Creek, Lower Bowns Reservoir and Wide Hollow Reservoir. Of these sixteen water bodies, six had fish with mean mercury concentrations greater than the UDOH level of concern of 0.30 mg/kg.

Five Brown Trout were collected from Calf Creek. The mean mercury concentration in these fish was 0.466, with a range of 0.349 to 0.685 mg/kg. **The mean mercury concentration in Brown Trout from Calf Creek was statistically significantly ($p = 0.026$) greater that 0.30 mg/kg, and warrants a consumption advisory.**

Three Brown Trout collected from Mamie Creek were greater than the UDOH level of concern of 0.30 mg/kg, with mean value of 0.396 mg/kg and a range of 0.326 to 0.519 mg/kg. However, the mean mercury concentration was not statistically greater than 0.30 mg/kg.

Two of six Rainbow Trout sampled from Panguitch Lake were greater than 0.30 mg/kg. The mean mercury concentration in fish from Panguitch Lake was 0.321 mg/kg, with range of 0.212 mg/kg to 0.475 mg/kg. This reservoir was chemically treated in the fall of 2006 to remove all

fish and re-stocked with trout. The mean mercury concentration was not statistically significantly greater than the UDOH level of concern of 0.30 mg/kg.

Four of the five Brown Trout collected from Pine Creek were greater than 0.30 mg/kg. The mean mercury concentration in these fish was 0.386 mg/kg, with a low value of 0.202 mg/kg and a high value of 0.558 mg/kg. However, the mean mercury concentration in Brown Trout from Pine Creek was not statistically significantly ($p = 0.116$) greater than 0.30 mg/kg, and therefore, would not warrant a consumption advisory.

The mean mercury concentration in Brown Trout collected from Sand Creek was 0.395 mg/kg. Mercury concentrations ranged from 0.255 to 0.802 mg/kg, with only two of the five fish collected with values greater than 0.30 mg/kg. The mean mercury concentration in Brown Trout from Sand Creek was not statistically significantly ($p = 0.210$) greater than 0.30 mg/kg, and therefore would not warrant a consumption advisory.

Ten Bluegill were collected from Wide Hollow Reservoir. Five of the ten Bluegill sampled had mercury concentrations greater than 0.30 mg/kg. The mean mercury concentration in these fish was 0.365 mg/kg, and ranged in concentrations from 0.186 to 0.557 mg/kg. However, the mean mercury concentration was not statistically significantly greater than the UDOH level of concern of 0.30 mg/kg.

One of five Brown Trout collected from Deer Creek was greater than 0.30 mg/kg (0.306 mg/kg), however the mean mercury concentrations of the five fish was 0.268 mg/kg, below the level of concern.

One of five Brown Trout collected from Mammoth Creek and one of three Brown Trout collected from Antimony Creek was over the 0.30 mg/kg standard. However, mean mercury concentrations were 0.210 mg/kg and 0.159 mg/kg respectively, below the level of concern.

A map showing the location where the Brown Trout from Calf Creek was sampled is presented in Appendix A, Figure 3. A summary of the mercury concentration in fish sampled in Garfield County is presented in Appendix B, Table 7.

Grand County

Four sites were sampled in Grand County. Five Cutthroat from Fisher Creek, five Brown Trout from Castle Creek, three Largemouth Bass from Negro Bill Canyon, and three Brown Trout from South Fork of Mill Creek. Mercury concentrations in these fish ranged from 0.018 mg/kg to a high of 0.182 mg/kg and were well below the UDOH level of concern.

A summary of the mercury concentration in fish sampled in Grand County is presented in Appendix B, Table 8.

Iron County

The only water body sampled in Iron County was Newcastle Reservoir. Five Rainbow Trout were collected. All five fish sampled were above the UDOH level of concern of 0.30 mg/kg. The mean mercury concentration in these fish was 0.475 mg/kg, with a low value of 0.401 mg/kg and a high value of 0.524 mg/kg. **The mean mercury concentration in Rainbow Trout from Newcastle Reservoir was statistically significantly (p = 0.001) greater than 0.30 mg/kg, and would warrant a consumption advisory.**

A map showing the Newcastle Reservoir sample location for Rainbow Trout is presented in Appendix A, Figure 4. A summary of the mercury concentration in fish sampled in Iron County is presented in Appendix B, Table 9.

Kane County

Five Brook Trout were sampled from East Fork of the Sevier River. The mean mercury concentration was 0.080 mg/kg, with a range of 0.029 to 0.220 mg/kg. All were below the UDOH level of concern of 0.30 mg/kg.

A summary of the mercury concentration in fish sampled in Kane County is presented in Appendix B, Table 10.

Millard County

Fish samples were collected from Corn Creek (5 Brown Trout), North Fork of South Fork Chalk Creek (5 Brown Trout), South Fork Chalk Creek near Pistol Rock (5 Cutthroat Trout), and Sevier River (5 Common Carp, 5 Channel Catfish, 5 Black Crappie). None of the fish analyzed were above the UDOH level of concern of 0.30 mg/kg. Mercury concentrations ranged from 0.018 mg/kg to a high of 0.142 mg/kg.

A summary of the mercury concentration in fish sampled in Millard County is presented in Appendix B, Table 11.

Morgan County

Fish were sampled from East Canyon Creek and the Weber River in Morgan County. Five Brown Trout and five Mountain Whitefish were analyzed for mercury from East Canyon Creek. Concentrations ranging from a low of 0.082 mg/kg to a high of 0.243 mg/kg were all below the UDOH level of concern.

All five Brown Trout collected from the Weber River had concentrations of mercury greater than EPA's level of concern of 0.30 mg/kg. The mean mercury concentration in these fish was 0.443 mg/kg with a range of 0.389 mg/kg to 0.558 mg/kg. **The mean mercury concentration in Brown Trout from the Weber River in Morgan County was statistically significantly (p = 0.004) greater than 0.30 mg/kg, and warrants a consumption advisory.**

A map showing the Weber River sample location for Brown Trout is presented in Appendix A, Figure 5. A summary of the mercury concentration in fish sampled in Morgan County is presented in Appendix B, Table 12.

Piute County

Six water bodies were sampled in Piute County, which included Box Creek (five Brown Trout), Otter Creek (three Brown Trout), Otter Creek Reservoir (ten Rainbow Trout), Pine Creek (three Cutthroat Trout), Shingle Creek (two Cutthroat Trout) and Piute Reservoir (ten Rainbow Trout). None of the mean mercury concentrations in the fish sampled exceeded the UDOH level of concern of 0.30 mg/kg. Two of the five Brown Trout from Box Creek were above the level of concern, with a mean concentration of 0.243 mg/kg and a range of 0.135 mg/kg to 0.445 mg/kg. One out of ten Rainbow Trout collected from Piute Reservoir slightly exceeded the level of concern. Mean mercury concentration in Rainbow Trout collected from Piute Reservoir was 0.210 with a range of 0.143 mg/kg to 0.310 mg/kg.

A summary of the mercury concentration in fish sampled in Piute County is presented in Appendix B, Table 13.

Rich County

Three different species were collected from Bear Lake that included ten Cutthroat Trout, ten Bonneville Whitefish, and two Lake Trout. The mean concentrations for each species were below the UDOH level of concern. One Cutthroat Trout exceeded the 0.30 mg/kg level of concern. None of the other fish sampled exceeded the level of concern. Concentrations of mercury in fish collected from Bear Lake ranged from a low of 0.025 mg/kg to a high of 0.334 mg/kg that was found in one Cutthroat Trout.

A summary of the mercury concentration in fish sampled in Rich County is presented in Appendix B, Table 14.

Salt Lake County

Three Brown Trout were sampled from Big Cottonwood Creek in Salt Lake County. The mean mercury concentration in those fish sampled was 0.040 mg/kg, with a range of 0.040 to 0.071 mg/kg.

A summary of the mercury concentration in fish sampled in Salt Lake County is presented in Appendix B, Table 15.

San Juan County

Five water bodies were sampled in San Juan County that included Geyser Creek (five Cutthroat Trout), Kens Lake (ten Largemouth Bass, ten Rainbow Trout, two Brown Trout), LaSal Creek (two Rainbow Trout, five Brook Trout), Johnson Creek (three Brook Trout) and several locations in Lake Powell (19 Smallmouth Bass, 45 Striped Bass, four Channel Catfish). None of the fish

sampled in Geyser Creek, LaSal Creek, or Johnson Creek exceeded the UDOH level of concern of 0.30 mg/kg.

Two of the ten Largemouth Bass collected from Kens Lake exceeded the UDOH level of concern of 0.30 mg/kg. However the mean concentration of mercury in these fish was 0.238 mg/kg, with a range in values from 0.152 mg/kg to a high of 0.366 mg/kg.

Of the fish collected from Lake Powell, five exceeded the UDOH level of concern of 0.30 mg/kg. Five out of the ten Striped Bass collected at Lone Rock in Lake Powel were greater than 0.30 mg/kg, with a mean mercury concentration of 0.280 mg/kg and a range of 0.134 to 0.369 mg/kg.

A summary of the mercury concentration in fish sampled in San Juan County is presented in Appendix B, Table 16.

Sanpete County

Four water bodies were sampled in Sanpete County that included Gooseberry Creek (3 Cutthroat Trout), Manti Creek (5 Rainbow Trout), San Pitch River (10 Brown Trout), and Twelve Mile Creek (5 Cutthroat Trout). None of the fish sampled exceeded the UDOH level of concern of 0.30 mg/kg. Mercury concentrations ranged from a low of 0.038 mg/kg to a high concentration of 0.250 mg/kg.

A summary of the mercury concentration in fish sampled in Sanpete County is presented in Appendix B, Table 17.

Sevier County

Brown Trout were collected from Salina Creek (4), Clear Creek (3) and Sevier River (3) in Sevier County. Four Cutthroat Trout were also collected from Salina Creek.

Mean concentrations of mercury in Brown Trout and Cutthroat Trout collected from Salina Creek were slightly below the UDOH level of concern of 0.30 mg/kg. Mean mercury concentration of the four Brown Trout from Salina Creek was 0.294 mg/kg, with a range of 0.122 mg/kg to 0.509 mg/kg. The mean mercury concentration in four Cutthroat Trout collected from Salina Creek was 0.285 mg/kg with a range of 0.186 mg/kg to 0.407 mg/kg.
The mean mercury concentration in three Brown Trout collected from Sevier River was 0.328 mg/kg, with a range of 0.187 mg/kg to 0.502 mg/kg. However, the mean mercury concentration was not statistically significantly greater than the UDOH level of concern of 0.30 mg/kg.

None of the Brown Trout sampled from Clear Creek exceeded the UDOH level of concern of 0.30 mg/kg.

A summary of the mercury concentration in fish sampled in Sevier County is presented in Appendix B, Table 18.

Summit County

Seven water bodies were sampled in Summit County that included Bear River (five Cutthroat and five Brook Trout), Beaver Creek (five Brown Trout), Blacks Fork River (two Brook Trout, three Cutthroat Trout, one Mountain Whitefish), Provo River (five Brown Trout, five Mountain Whitefish), Sawmill Creek (five Cutthroat Trout), West Fork Beaver Creek (five Brook Trout), and Weber River (15 Brown Trout, five Common Carp, five Mountain Whitefish). None of the mean mercury concentrations in the fish sampled in Summit County exceeded the UDOH level of concern of 0.30 mg/kg. Three fish sampled had mercury concentrations above 0.30 mg/kg, which included one Brown Trout collected from Beaver Creek (0.365 mg/kg), one Brown Trout from the Provo River (0.349 mg/kg) and one Common Carp collected from the Weber River (0.396 mg/kg).

A summary of the mercury concentration in fish sampled in Summit County is presented in Appendix B, Table 19.

Tooele County

Two sites were sampled in Tooele County that included five Brown Trout from Clover Creek and five Rainbow Trout from South Willow Creek. None of the fish sampled from these two creeks exceeded the UDOH level of concern. Mercury concentrations in fish from these sites ranged from 0.012 to 0.041 mg/kg.

A summary of the mercury concentration in fish sampled in Tooele County is presented in Appendix B, Table 20.

Uinta County

Six sites were sampled in Uinta County which included five Brown Trout from Ashley Creek, five Rainbow Trout from Big Brush Creek, five Brook Trout and five Rainbow Trout from Carter Creek, ten Channel Catfish from the Green River, five Rainbow Trout from North Fork of Ashley Creek and three Brook Trout from Whiterocks River. None of the mean mercury concentrations exceeded the 0.30 mg/kg level of concern. Four fish collected had mercury concentrations greater than 0.30 mg/kg, which included one Brook Trout from Carter Creek (0.435 mg/kg) and three Channel Catfish from the Green River with a high value of 0.374 mg/kg.

In previous sampling of the Green River in Desolation Canyon in September 2005, ten Channel Catfish were collected as a follow-up to elevated mercury levels found in Channel Catfish from sampling conducted in 2002. The Channel Catfish in that sample had a wet weight mercury range of 0.24 mg/kg to 0.91 mg/kg with an average value of 0.51 mg/kg. Based on those results, a fish consumption advisory for Channel Catfish from Desolation Canyon was issued (Scholl 2005b).

A summary of the mercury concentration in fish sampled in Uinta County is presented in Appendix B, Table 21.

Utah County

Five water bodies were sampled in Utah County that included Bennion Creek (five Cutthroat Trout), Clear Creek (three Cutthroat Trout), Diamond Fork Creek (five Brown Trout), Soldier Creek (five Brown Trout) and Utah Lake (five White Bass, one Walleye, five Black Bullhead, one Channel Catfish, one Black Crappie). None of the mean mercury concentrations in fish sampled from these water bodies exceeded the UDOH level of concern of 0.30 mg/kg. Mercury concentrations ranged from 0.023 mg/kg to a high of 0.287 mg/kg.

A summary of the mercury concentration in fish sampled in Utah County is presented in Appendix B, Table 22.

Wasatch County

Reservoirs and creeks sampled in Wasatch County include Deer Creek Reservoir (10 Rainbow Trout, five Brown Trout, five Walleye), Jordanelle Reservoir (10 Brown Trout, five Yellow Perch, 10 Rainbow Trout), Little Deer Creek (five Brown Trout), Right Fork Current Creek (five Cutthroat Trout) and Strawberry Reservoir (five Kokanee, two Utah Sucker, six Cuttthroat Trout). Mean concentrations of mercury in fish collected from Deer Creek, Little Deer Creek, Right Fork Currant Creek, and Strawberry Reservoir were all below the UDOH level of concern of 0.30 mg/kg.

Two of five Walleye sampled from Deer Creek had mercury concentrations above 0.30 mg/kg. Mean mercury concentration in the Walleye was 0.254 mg/kg, with a range of 0.158 mg/kg to a high concentration of 0.344 mg/kg. Mean mercury concentrations in other fish collected from Deer Creek Reservoir were 0.050 mg/kg, 0.078 mg/kg, and 0.055 mg/kg in Rainbow Trout, Brown Trout and Rainbow Trout, respectively.

Mean mercury concentrations in Little Deer Creek Brown Trout and Currant Creek Cutthroat Trout were 0.069 mg/kg and 0.064 mg/kg, respectively. Well below the level of concern.

One Cutthroat Trout from Strawberry Reservoir slight exceeded the 0.30 mg/kg level of concern. Mean mercury concentration in the Cutthroat Trout was 0.174 mg/kg, with a range of 0.145 mg/kg to 0.305 mg/kg. The mean mercury concentration in Kokanee and Utah Sucker from Strawberry Reservoir was 0.080 mg/kg and 0.131 mg/kg, respectively.

Ten Rainbow Trout collected from Jordanelle Reservoir had a mean mercury concentration of 0.097 mg/kg, with a range of a low concentration of 0.046 mg/kg and a high value of 0.151 mg/kg. Well below the level of concern of 0.30 mg/kg.

Ten Brown Trout and five Yellow Perch were collected from Jordanelle Reservoir, with mean mercury concentrations of 0.414 mg/kg and 0.307 mg/kg respectively, exceeding the UDOH level of concern of 0.30 mg/kg. Five out of the ten Brown Trout exceeded the level of concern, with mercury concentrations ranging from a low of 0.143 mg/kg to a high of 0.805 mg/kg. Two of the five Yellow Perch exceeded the level of concern, with a range of concentrations from 0.193 mg/kg to 0.483 mg/kg. The mean mercury concentration in Yellow Perch was not

statistically significantly greater than the UDOH level of concern of 0.30 mg/kg. **The mean mercury concentration in Brown Trout from Jordanelle Reservoir was statistically significantly (p = 0.036) greater than 0.30 mg/kg, and warrants a consumption advisory.**

A map showing the sample location of Brown Trout from Jordanelle Reservoir is presented in Appendix A, Figure 6. A summary of the mercury concentration in fish sampled in Wasatch County is presented in Appendix B, Table 23.

Washington County

Five sites were sampled in Washington County. Five Mountain Sucker were collected from Beaver Dam, five Rainbow trout from Pinto Creek, three Mountain Sucker from East Fork of the Virgin River, three Brook Trout from Middle Fork of the Santa Clara River, and five Rainbow Trout from Upper Enterprise Reservoir. Mean mercury concentrations from Beaver Dam, Pinto Creek, Virgin River and the Santa Clara River were all below the level of concern of 0.30 mg/kg. One Mountain Sucker collected from Beaver Dam exceeded the level of concern. Mean mercury concentration in Mountain Sucker from Beaver Dam was 0.185 mg/kg with a range of 0.122 mg/kg to 0.305 mg/kg.

All five Rainbow Trout collected from Upper Enterprise Reservoir exceeded the UDOH level of concern of 0.30 mg/kg. The mean mercury concentration in Rainbow Trout was 0.655 mg/kg, with a low concentration of 0.551 mg/kg and a high concentration of 0.746 mg/kg. **The mean mercury concentration in Rainbow Trout from Upper Enterprise Reservoir was statistically significantly (p = 0.0003) greater than 0.30 mg/kg, and warrants a consumption advisory.**

A map showing the Upper Enterprise Reservoir sample location for Rainbow Trout is presented in Appendix A, Figure 4. A summary of the mercury concentration in fish sampled in Washington County is presented in Appendix B, Table 24.

Wayne County

Ten Brown Trout were collected from two sites from the Fremont River in Wayne County. Mean mercury concentrations from both sites were well below the level of concern. One trout collected from the Fremont River slightly exceeded the 0.30 mg/kg level of concern. The mean mercury concentration in trout collected from the Fremont River was 0.080 mg/kg, with a range of 0.031 mg/kg to 0.308 mg/kg..

A summary of the mercury concentration in fish sampled in Wayne County is presented in Appendix B, Table 25.

Weber County

Four water bodies were sampled in Weber County, that include South Fork Ogden River (five Brown Trout), Weber River (five Rainbow Trout, four Brown Trout), Willard Bay (nine

Walleye, ten Wiper, ten Channel Catfish), Causey Reservoir (eight Kokanee, one Tiger Trout, one Splake Trout).

Brown Trout collected from the Weber River were the only fish sampled in Weber County that exceeded the UDOH level of concern of 0.30 mg/kg. The mean mercury concentration in Brown Trout sampled from the Weber River was 0.333 mg/kg, with a range of 0.230 mg/kg to a high of 0.454 mg/kg. Two of the four Brown Trout collected exceeded the level of concern. However, the mean mercury concentration in Brown Trout was not statistically significantly greater than the UDOH level of concern of 0.30 mg/kg.

Rainbow Trout collected from the Weber River were well below the level of concern with a mean mercury concentration of 0.060 mg/kg.

Mercury concentrations in fish collected from Willard Bay were well below the UDOH level of concern of 0.30 mg/kg. Mercury concentrations ranged from 0.034 mg/kg to a high concentration of 0.243 mg/kg.

Fish collected from Causey Reservoir ranged from a low mercury concentration of 0.118 mg/kg to a high concentration of 0.239 mg/kg. All values were below the level of concern.

A summary of the mercury concentration in fish sampled in Weber County is presented in Appendix B, Table 26.

Lake Powell

Five locations and three different species of fish were sampled from Lake Powell. These included: five Smallmouth Bass and 10 Striped Bass from Good Hope Bay; five Smallmouth Bass and 10 Striped Bass from Rincon; four Smallmouth Bass near old Waheap Lagoons; 10 Striped Bass near Lone Rock; and four Channel Catfish, 10 Striped Bass, and five Smallmouth Bass near Neskahi Canyon. Of the fish collected from Lake Powell, five exceeded the UDOH level of concern of 0.30 mg/kg. Five out of the ten Striped Bass collected at Lone Rock were greater than 0.30 mg/kg, with a mean mercury concentration of 0.280 mg/kg and a range of 0.134 to 0.369 mg/kg. Sampling locations are presented in Appendix A, Figure 7.

Previous fish sampling from Lake Powell

The U.S. Fish and Wildlife Service conducted a reconnaissance study of trace elements in sediment and biota of Lake Powell during 1991 through 1994 (USFWS 1996). One of the objectives of that study was to determine the trace element concentration in fish for comparison with human health thresholds. Mercury was one of the metals analyzed in that study. Mercury concentrations were determined from fish fillets. Results for 1991-1994 data from Lake Powell were presented in an earlier report (Scholl 2006). Locations sampled in Lake Powell for that study included: *Bullfrog Bay, Cha Canyon, Colorado River, Dangling Rope, Dirty Devil, Escalante Arm, Good Hope Bay, Hite Marina, Narrow Canyon, Navajo Canyon, North Wash, Oak Canyon, Wahweap, Warm Creek, and Zahn Bay.* Locations of the sample sites of the 1991 - 1994 study of Lake Powell are presented in Appendix A, Figure 8.

Several of those sites in Lake Powell had average concentrations and individual fish with concentrations above the UDOH level of concern of 0.30 mg/kg based on analytical results from 1991-1994. Those sites included: Striped Bass from Cha Canyon, Striped Bass from the Colorado River, Striped Bass from Dangling Rope, Striped Bass from Dirty Devil, Striped Bass and Largemouth Bass from the Escalante Arm, Striped Bass from Narrow Canyon, Smallmouth Bass from Wahweep, and Striped Bass from Zahn Bay. For these sites the sample size was small (two or three fish), which limited the conclusion that could be made from the data.

Data from the 1991/1994 study suggested that Lake Powell might have fish with elevated mercury concentrations. Sites that had fish with mercury concentrations above 0.30 mg/kg were re-evaluated in 2005. Those sites included Rock Canyon and Navajo Canyon. The mean concentration in five Striped Bass sampled was slightly above the UDOH level of concern of 0.30 mg/kg. The mean value of mercury in five Striped Bass were caught from Navajo Canyon was below the level of concern of 0.30 mg/kg, however the high value exceeded 0.30 mg/kg. Based on the confirmation sampling of fish fillets conducted in July 2005, average concentrations of mercury exceeded the UDOH level of concern of 0.30 mg/kg at 0.32 mg/kg in Striped Bass from Rock Canyon, Lake Powell. Sample location of sites in 2005 is presented in Appendix A, Figure 9.

Additional sampling at Rock Canyon is needed to adequately characterize the potential public health hazard from eating fish from this area of Lake Powell. Further sampling in various areas of Lake Powell is needed to determine which regions of the lake may pose a hazard due to mercury contamination.

The previous report recommended priority sites for confirmation sampling in Striped Bass in Lake Powell in areas where the mercury in fish exceeded the UDOH level of concern of 0.30 mg/kg. Those sites included: Cha Canyon, Colorado River, Dangling Rope, Dirty Devil, Escalante Arm, Wahweap, and Zahn Bay.

Discussion

Toxicological Effects of Mercury

In fish tissue, the majority of mercury is methylmercury. Methylmercury is one of the most toxic forms of mercury. The amount of mercury in fish tissue tends to increase with the age and size of the fish. Fish-eating species of fish also accumulate higher concentrations of mercury than non-piscivorous (fish-eating) fish (EPA 2000). Methylmercury is rapidly absorbed from the gastrointestinal tract. The body absorbs about 90 to 100 percent of ingested methylmercury. Methylmercury can be changed by your body to inorganic mercury. Because inorganic mercury does not readily cross the blood brain barrier, conversion of the methylmercury to inorganic mercury in the brain results in the mercury being “trapped” in the brain for a long period of time. When methylmercury does leave your body after you have been exposed, it leaves slowly over a period of several months, mostly as inorganic mercury in the feces. The biological half-life of methylmercury in humans is roughly 50 to 65 days. The half-life is a measure of rate for the time

required to eliminate one half of a quantity of a chemical from the body. Some of the methylmercury in a nursing woman's body will pass into her breast milk (ATSDR 1999). The nervous system is very sensitive to all forms of mercury. In poisoning incidents that occurred in other countries, some people who ate fish contaminated with large amounts of methylmercury or seed grains treated with methylmercury or other organic mercury compounds developed permanent damage to the brain and kidneys. Animals exposed orally to long-term, high levels of methylmercury or phenylmercury in laboratory studies experienced damage to the kidneys, stomach, and large intestine; changes in blood pressure and heart rate; adverse effects on the developing fetus, sperm, and male reproductive organs; and increases in abortions and stillbirths (ATSDR 1999).

Mercury and methylmercury are not considered carcinogens. EPA lists mercury as "Not classifiable as to human carcinogenicity" and methylmercury as "Possible human carcinogen (no human, limited animal studies)". Both the National Toxicology Program (NTP) and the International Agency for Research on Cancer list mercury as "not classified" with respect to carcinogenicity. NTP also lists methylmercury as "not classified".

Mercury in fish is in the muscle tissue, therefore trimming and skinning the fish does not reduce the mercury content of the fillet portion (as with PCBs, dioxins, and pesticides) (ATSDR 1999).

Screening Value for Mercury

Screening Values (SVs) were developed by the U.S. Environmental Protection Agency (EPA) and are used as standards by which levels of contamination can be compared. Screening values are defined as the concentrations of target analytes in fish tissue that are of potential public health concern. Screening values are used to establish the concentration in fish that can trigger further investigation and/or consideration of fish advisories for the waterbodies and species where such concentrations occur (EPA 2000). Based on an adult body weight of 70 kg and a fish consumption rate of 0.0175 kg fish/day, EPA has calculated a fish tissue residue criterion for mercury to be 0.30 mg methylmercury/kg fish (EPA 2001). The Utah Department of Health has adopted the EPA screening value of 0.30 mg/kg as the level of concern or action level for mercury concentration in fish.

The Food and Drug Administration standard for mercury in fish is 1 mg/kg wet weight. Fish with concentrations higher than 1 mg/kg are considered tainted and cannot be sold for human consumption. The Agency for Toxic Substances and Disease Registry recommends a screening value of 0.9 mg/kg using a methodology similar to EPA. The EPA, FDA, and ATSDR screening values are all similar in concentration but the variation in SVs illustrates some of the uncertainties associated with developing SVs for mercury in fish.

As discussed in the section of toxicity of mercury, the toxic effects from higher exposures are obvious. The toxic effects from low exposures, for instance, close to the screening level, are subtle and more difficult to identify. The UDOH level of concern of 0.30 mg/kg is protective for long-term exposures and cannot be extrapolated to short term exposures such as occasional or one-time consumption. SVs for short term exposures would be higher than 0.30 mg/kg.

Consumption Limits

When SVs are exceeded, consumption limits can be estimated to determine how many meals of fish can be safely consumed each month (EPA 2000). Consumption limits do not apply to levels that do not exceed the SV or level of concern. Calculations are based on an adult body weight of 70 kg with a meal size of 227 g fish (about the size of a deck of cards) and a child body weight of 16 kg with a meal size of 113 g fish (Appendix C).

Consumption limits were calculated for those species of fish and water bodies where mean mercury concentrations that were statistically significantly ($p < 0.10$) greater than the UDOH level of concern of 0.30 mg/kg.

Joes Valley Reservoir, Emery County

Based on an average mercury concentration of 0.824 mg/kg in Splake Trout, adults can safely eat 1 eight-ounce meal per month, and pregnant women, women that may become pregnant or are breast-feeding and young children can eat 1 two-ounce meal per month of Splake Trout from Joes Valley Reservoir.

Calf Creek, Garfield County

Based on an average mercury concentration of 0.466 mg/kg in Brown Trout, adults can safely eat 2 eight-ounce meals per month, and pregnant women, women that may become pregnant or are breast-feeding and young children can eat 1 four-ounce meal per month of Brown Trout from Calf Creek.

Newcastle Reservoir, Iron County

Based on an average mercury concentration of 0.475 mg/kg in Rainbow Trout, adults can safely eat 2 eight-ounce meals per month, and pregnant women, women that may become pregnant or are breast-feeding and young children can eat 1 four-ounce meal per month of Rainbow Trout from Newcastle Reservoir.

Weber River, below Morgan City Lagoons

Based on an average mercury concentration of 0.443 mg/kg in Brown Trout, adults can safely eat 2 eight-ounce meals per month, and pregnant women, women that may become pregnant or are breast-feeding and young children can eat 1 four-ounce meal per month of Brown Trout from the Weber River.

Jordanelle Reservoir, Wasatch County

Based on an average mercury concentration of 0.562 mg/kg in Brown Trout, adults can safely eat 2 eight-ounce meals per month, and pregnant women, women that may become pregnant or are breast-feeding and young children can eat 1 four-ounce meal per month of Brown Trout from Jordanelle Reservoir.

Upper Enterprise Reservoir, Washington County

Based on an average mercury concentration of 0.655 mg/kg in Rainbow Trout, adults can safely eat 1 eight-ounce meal per month, and pregnant women, women that may become pregnant or are breast-feeding and young children can eat 1 two-ounce meal per month of Rainbow Trout from Upper Enterprise Reservoir.

National Fish Advisory

The Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) are advising women who may become pregnant, pregnant women, nursing mothers, and young children to avoid some types of fish and to only eat fish and shellfish that are lower in mercury (EPA 2004). The types of fish to avoid include Shark, Swordfish, King Mackerel or Tilefish because they contain high levels of mercury. Up to 12 ounces (2 average meals) a week of a variety of fish and shellfish can be eaten that are lower in mercury. The most commonly eaten fish that are low in mercury are shrimp, canned light tuna, Salmon, Pollock and Catfish. Another commonly eaten fish, Albacore ("white") Tuna has more mercury than canned light tuna. Up to 6 ounces (one average meal) of Albacore Tuna can be eaten per week.

Children's Health Considerations

The Utah Department of Health recognizes the unique vulnerabilities of infants and children to environmental contaminants. Children are less developed and may have developmental harm from exposure that would not be experienced by a completely developed adult. The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Children's health was considered as a part of this health consultation.

Very young children are more sensitive to mercury than adults. Mercury in the mother's body passes to the fetus and may accumulate there. It can also pass to a nursing infant through breast milk. However, the benefits of breast-feeding may be greater than the possible adverse effects of mercury in breast milk. Mercury's harmful effects that may be passed from the mother to the fetus include brain damage, mental retardation, incoordination, blindness, seizures, and inability to speak. Children poisoned by mercury may develop problems of their nervous and digestive systems, and kidney damage (ATSDR 1999).

Methylmercury that is in the blood of a pregnant woman will easily move into the blood of the developing child and then into the child's brain and other tissues. Like metallic mercury, methylmercury can be changed by the body to inorganic mercury. Inorganic mercury can remain in the body for a long time. Short-term, high-level exposure of laboratory animals to inorganic mercury has been shown to affect the developing fetus and may cause termination of the pregnancy (ATSDR 1999). Due to the possible health effects from mercury on the fetus, pregnant women should follow the consumption limits assigned to children.

Fish is an important component of a healthy diet. Fish is a source of low fat protein. Fish also contain polyunsaturated fatty acids (for instance, omega 3) that are beneficial to both adults and the developing fetus. Adequate fish consumption of fish low in mercury is encouraged

Conclusions

Six water bodies in Utah have mean mercury concentrations in fish that statistically significantly ($p < 0.10$) exceeded the UDOH level of concern of 0.30 mg/kg. Following are the water bodies that warrant fish consumption advisories:

- Splake Trout from Joes Valley Reservoir, Emery County
- Brown Trout from Calf Creek, Garfield County
- Rainbow Trout from Newcastle Reservoir, Iron County
- Brown Trout from Weber River, below Morgan City Lagoons, Morgan County
- Brown Trout from Jordanelle Reservoir, Wasatch County
- Rainbow Trout from Upper Enterprise Reservoir, Washington County

Concentrations of mercury in these fish are at levels that may result in a risk of increased adverse health effects if consumed above the consumption limit. Consumption limits of the number of meals of fish that can be safely consumed each month were calculated for each of these water bodies. Based on higher fish consumption rates, the potential for adverse health effects is higher for those consuming fish at a subsistence level. The EEP is not aware of people using these sites for subsistence fishing.

Other water bodies in Utah have mean mercury concentrations in fish that exceeded the UDOH level of concern of 0.30 mg/kg. However, the mean mercury concentration in fish from these water bodies were not statistically significantly greater than the UDOH level of concern of 0.30 mg/kg. Additional sampling of these water bodies is needed to determine if the mercury concentrations significantly exceed the UDOH level of concern.

- Brown and Rainbow Trout from Porcupine Reservoir in Cache County;
- Brown Trout from Red and Rock Creeks in Duchesene County;
- Brown Trout from Mamie Creek, Calf Creek, Pine Creek and Sand Creek in Garfield County;
- Rainbow Trout from Panquitch Lake in Garfield County;
- Bluegill from Wide Hollow Reservoir in Garfield County;
- Yellow Perch from Jordanelle Reservoir in Wasatch County,
- Brown Trout from Weber River in Weber County;
- Brown Trout from Sevier River in Sevier County.

These conclusions are accurate to the extent that the fish samples collected are representative of all fish caught and eaten from the water body. The mean (arithmetic average) concentration is the appropriate parameter for comparison because the UDOH level of concern is protective of chronic (long term) exposures. The exposure assumptions are based on a fisher that consumes

about 14 pounds of fish a year. This amount likely requires several fish and the average concentration of the fish is the most accurate estimate of exposure. When a larger number of samples are available (for instance, 10 fish), the confidence in the estimation of mean concentrations is higher. When a few samples are available (for instance, less than 5 fish), the confidence in the calculated mean is low. In general, no definitive conclusions can be drawn from sample sizes less than five. Larger water bodies (e.g., Lake Powell) or longer reaches of river (e.g., Green River) may require a larger number of samples than 10 to a have a high degree of confidence. As more data become available, statistical analyses can be conducted to identify the appropriate number of fish samples to achieve the desired confidence in the mean concentrations of mercury in fish for a water body.

Recommendations

Fish consumption limits are recommended for those species of fish and waterbodies with mean mercury concentrations that were statistically significantly greater than the UDOH level of concern of 0.30 mg/kg.

The following table presents recommended consumption limits.

Site	Species	Recommended Consumption Limits	
		Adults (8 oz meals/month)	Pregnant Women and Children (4 oz meals/month)
Joes Valley Reservoir – Emery County	Splake Trout	1	0.5 (1 two-oz meal)
Calf Creek – Garfield County	Brown Trout	2	1
Newcastle Reservoir – Iron County	Rainbow Trout	2	1
Weber River – Morgan County	Brown Trout	2	1
Jordanelle Reservoir – Wasatch County	Brown Trout	2	1
Upper Enterprise Reservoir – Washington County	Rainbow Trout	1	0.5 (1 two-oz meal)

These consumption limits are based on the average mercury concentrations found in Splake Trout from Joes Valley Reservoir, Brown Trout from Calf Creek, Rainbow Trout from Newcastle Reservoir, Brown Trout from Weber River, Brown Trout from Jordanelle Reservoir and Rainbow Trout from the Upper Enterprise Reservoir.

Additional sampling of fish for mercury in those water bodies with fish samples that exceeded 0.30 mg/kg mercury should be conducted to delineate the extent of the mercury contamination in the fish from that respective water body. Sampling should include multiple species of game fish.

Priority sites for confirmation sampling in water bodies should be those areas where the mean mercury concentration in fish exceeded the UDOH level of concern of 0.30 mg/kg. A map showing areas of concern is presented in Appendix A, Figure 10. Those areas of concern include:

- Porcupine Reservoir, Cache County (Brown Trout),
- Red Creek, Duchesne County (Brown Trout),
- Rock Creek, Duchesne County (Brown Trout),
- Joes Valley Reservoir, Emery County (Splake Trout),
- Calf Creek, Garfield County (Brown Trout),
- Mamie Creek, Garfield County (Brown Trout),
- Panquitch Lake, Garfield County (Rainbow Trout),
- Pine Creek, Garfield County (Brown Trout),
- Sand Creek, Garfield County (Brown Trout),
- Wide Hollow Reservoir, Garfield County (Bluegill),
- Newcastle Reservoir, Iron County (Rainbow Trout),
- Weber River, Weber and Morgan Counties (Brown Trout),
- Sevier River, Sevier County (Brown Trout),
- Jordanelle Reservoir, Wasatch County (Perch and Brown Trout),
- Upper Enterprise Reservoir, Washington County (Rainbow Trout).

Author

Report Prepared By:

R. Wayne Ball, Ph.D., DABT
Toxicologist/Program Manager
Environmental Epidemiology Program
Utah Department of Health

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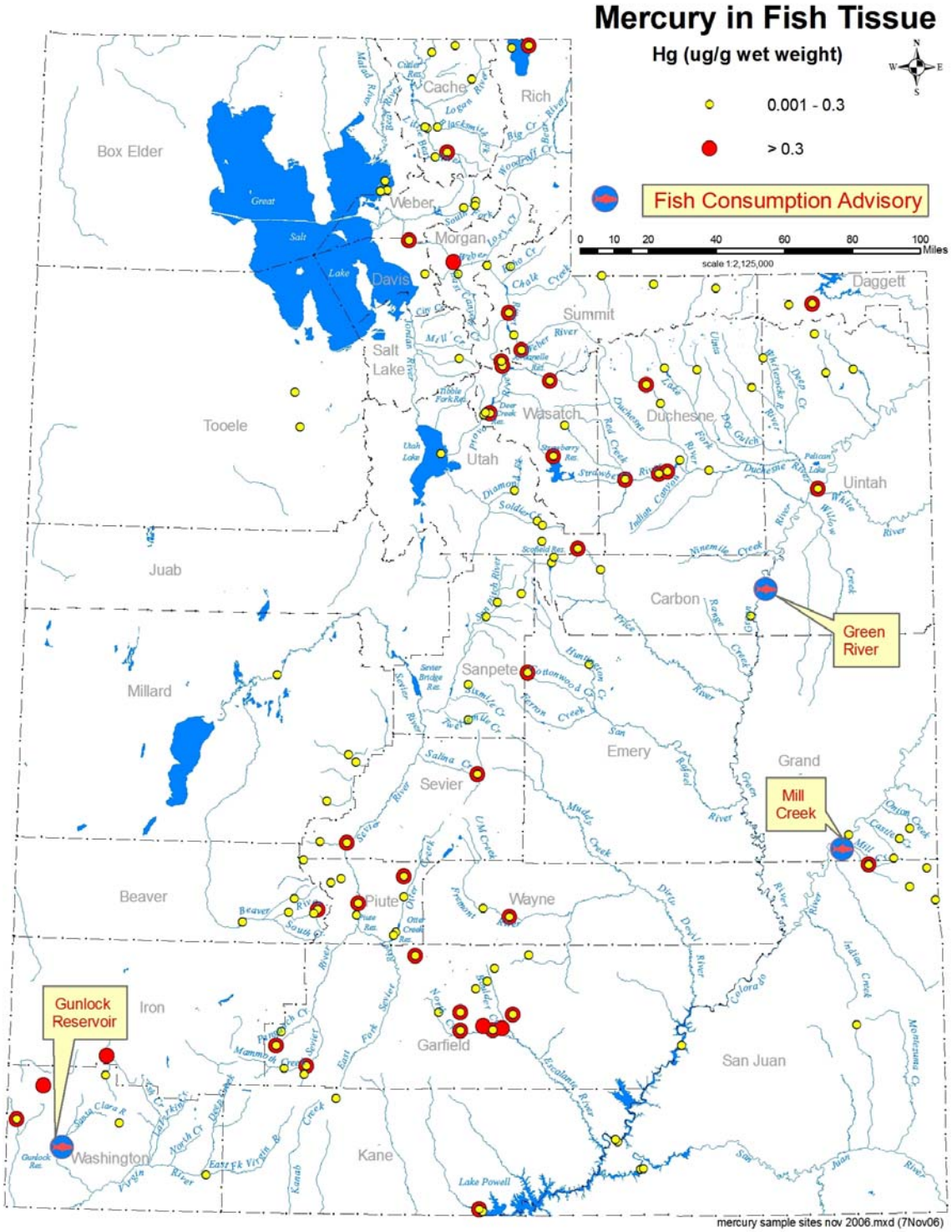
Appendix

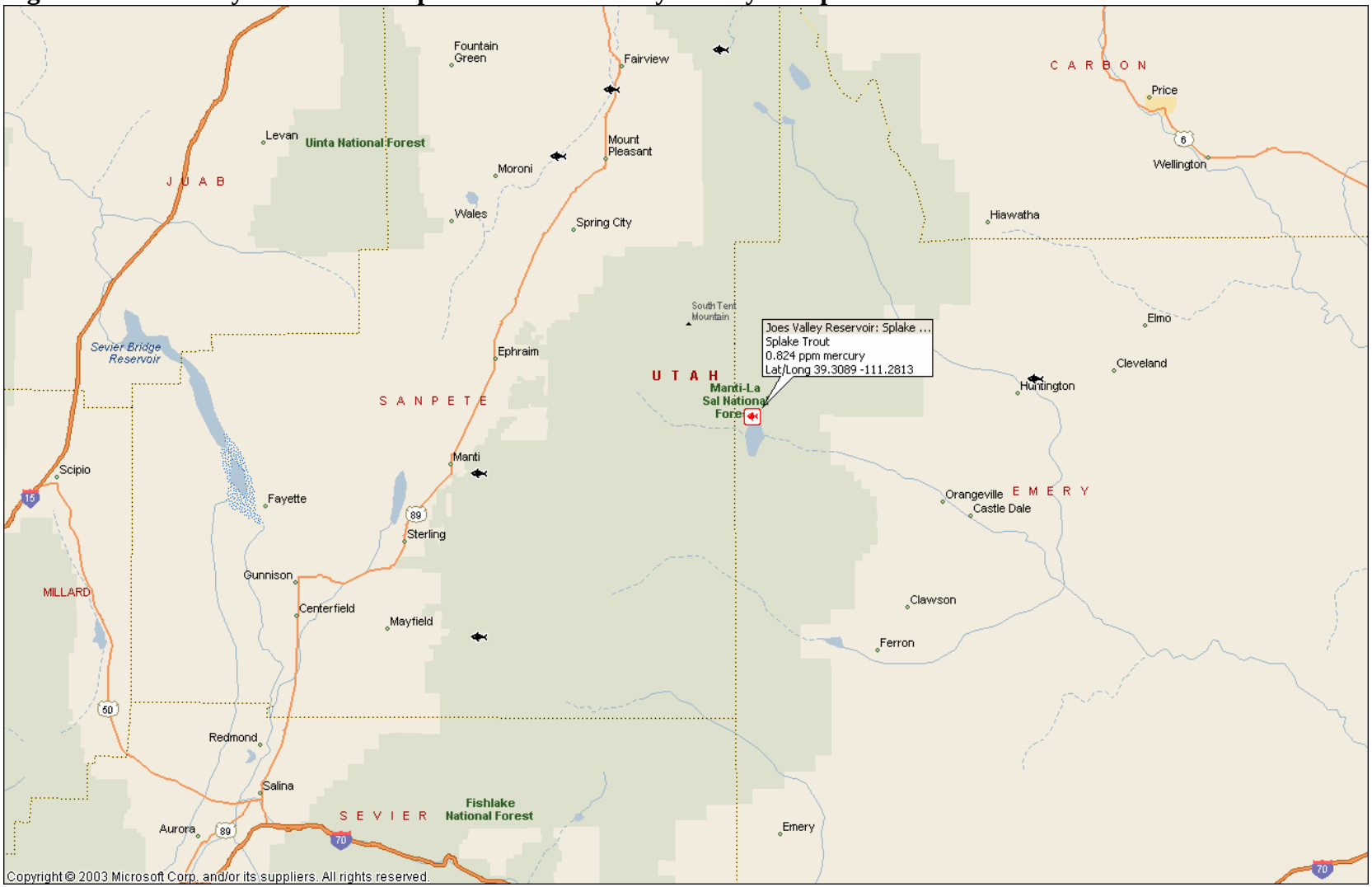
Appendix A: Maps

Figure 1. Location of Fish Sampling Sites 2004-2006



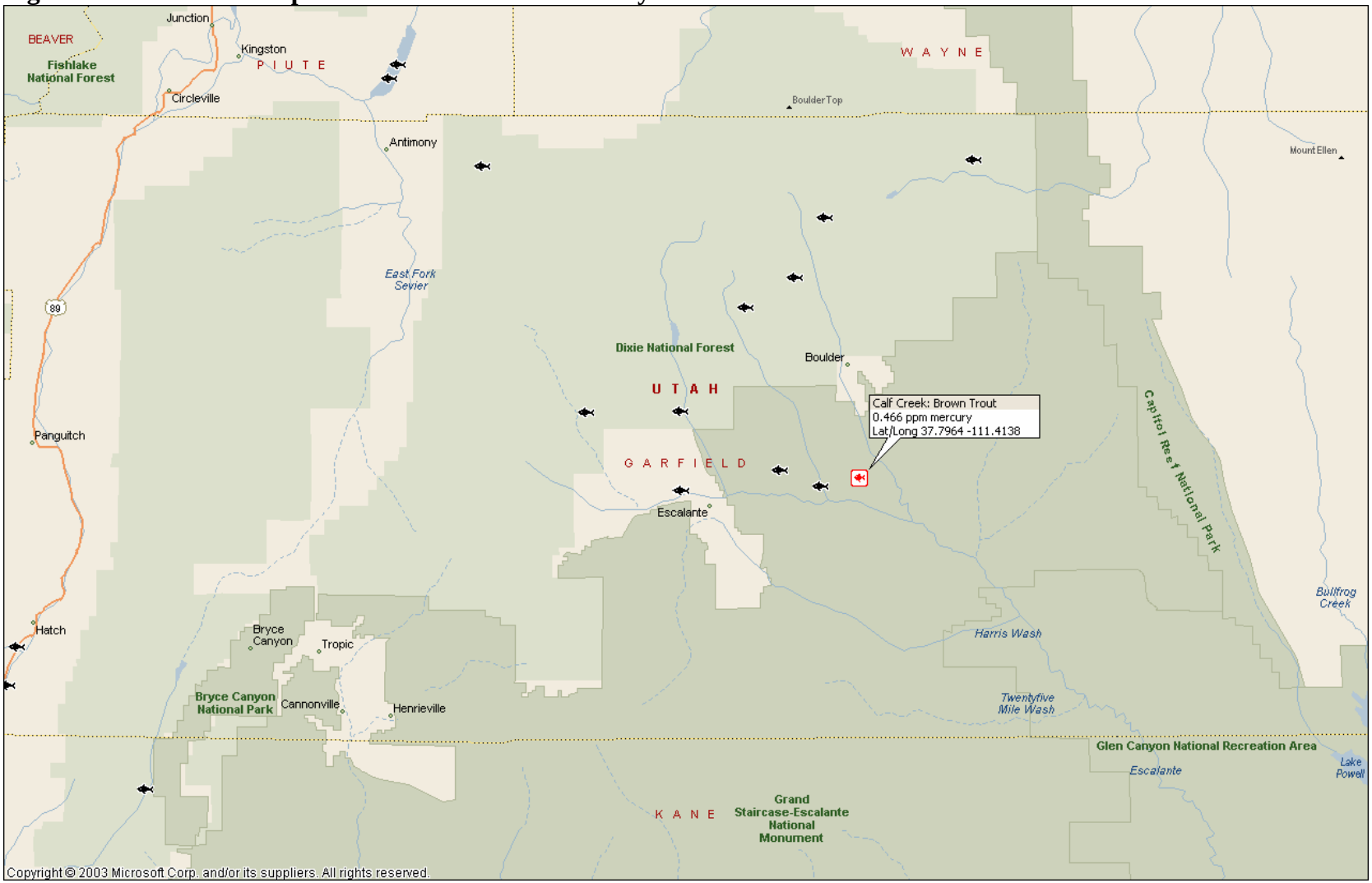
(Utah Department of Environmental Quality 2007)

Figure 2. Joes Valley Reservoir Sample Location in Emery County for Splake Trout



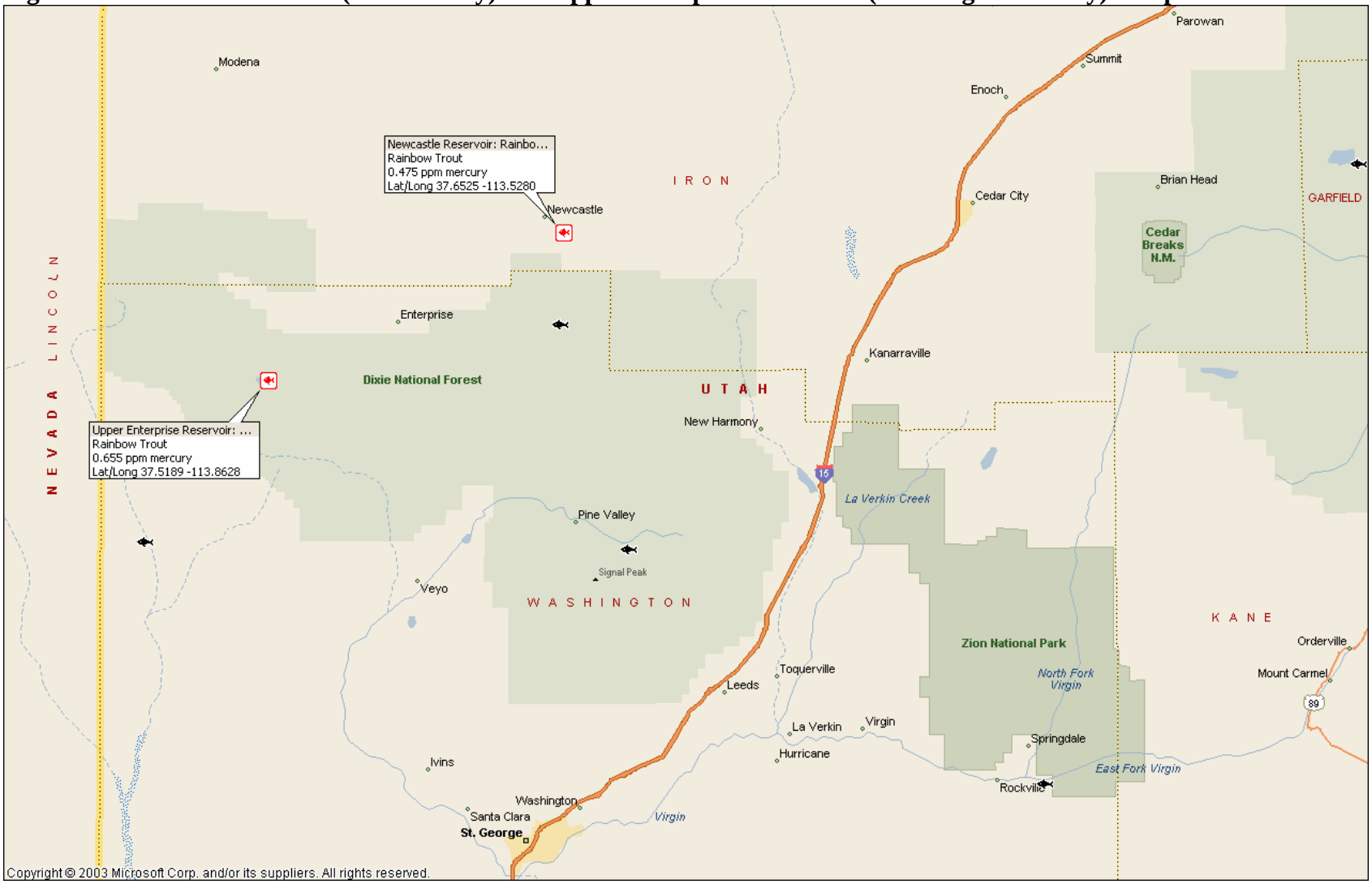
Fish symbols identify location of fish sampling. Red symbol is location where mean mercury concentration is significantly greater than 0.30 mg/kg.

Figure 3. Calf Creek Sample Location in Garfield County for Brown Trout



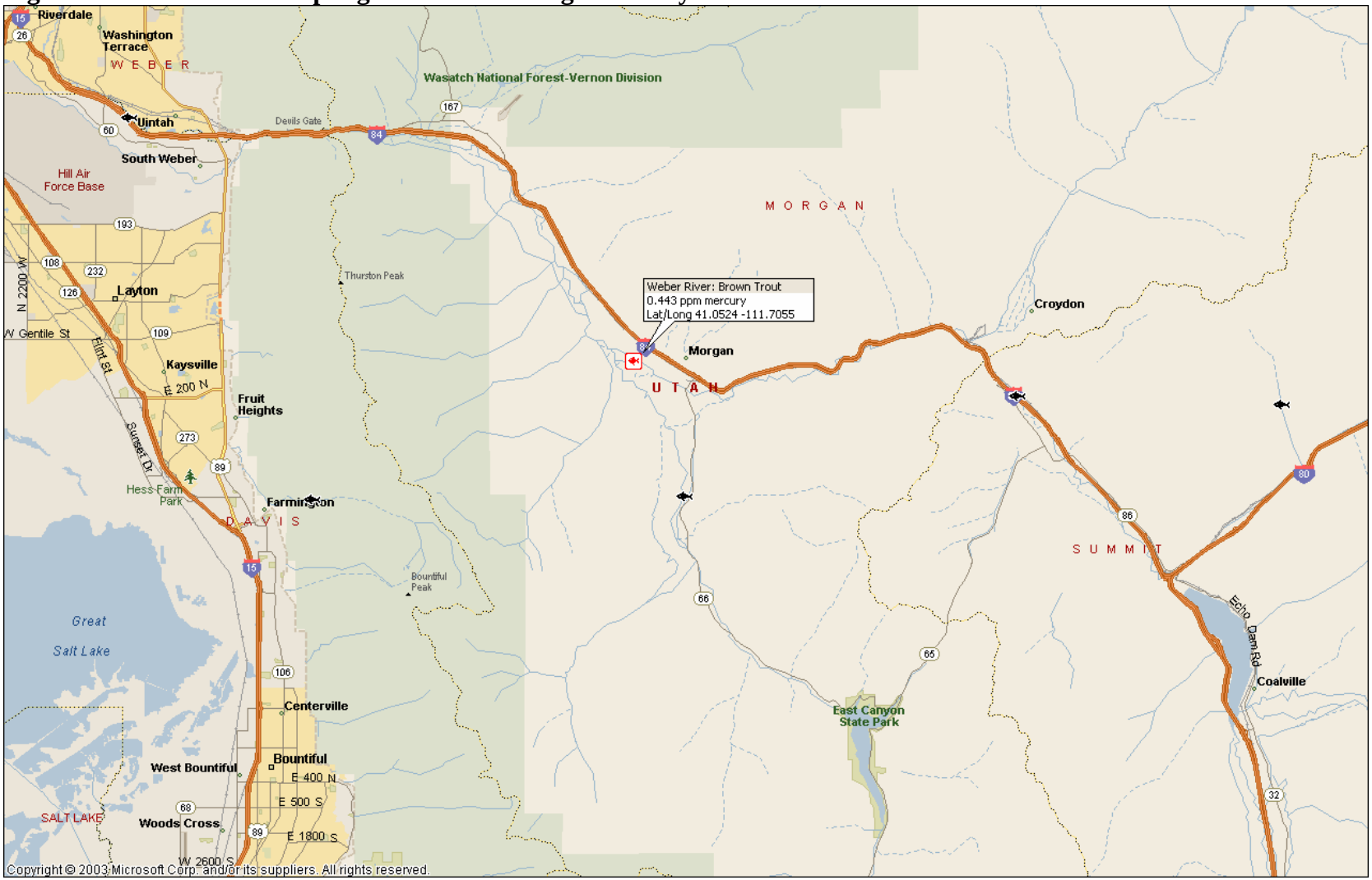
Fish symbols identify location of fish sampling. Red symbol is location where mean mercury concentration is significantly greater than 0.30 mg/kg.

Figure 4. Newcastle Reservoir (Iron County) and Upper Enterprise Reservoir (Washington County) Sample Locations



Fish symbols identify location of fish sampling. Red symbol is location where mean mercury concentration is significantly greater than 0.30 mg/kg.

Figure 5. Weber River Sampling Location in Morgan County: Brown Trout



Fish symbols identify location of fish sampling. Red symbol is location where mean mercury concentration is significantly greater than 0.30 mg/kg.

Figure 6. Jordanelle Reservoir in Wasatch County Sample Location for Brown Trout

Fish symbols identify location of fish sampling. Red symbol is location where mean mercury concentration is significantly greater than 0.30 mg/kg.

Figure 7. Sampling Sites in Lake Powell

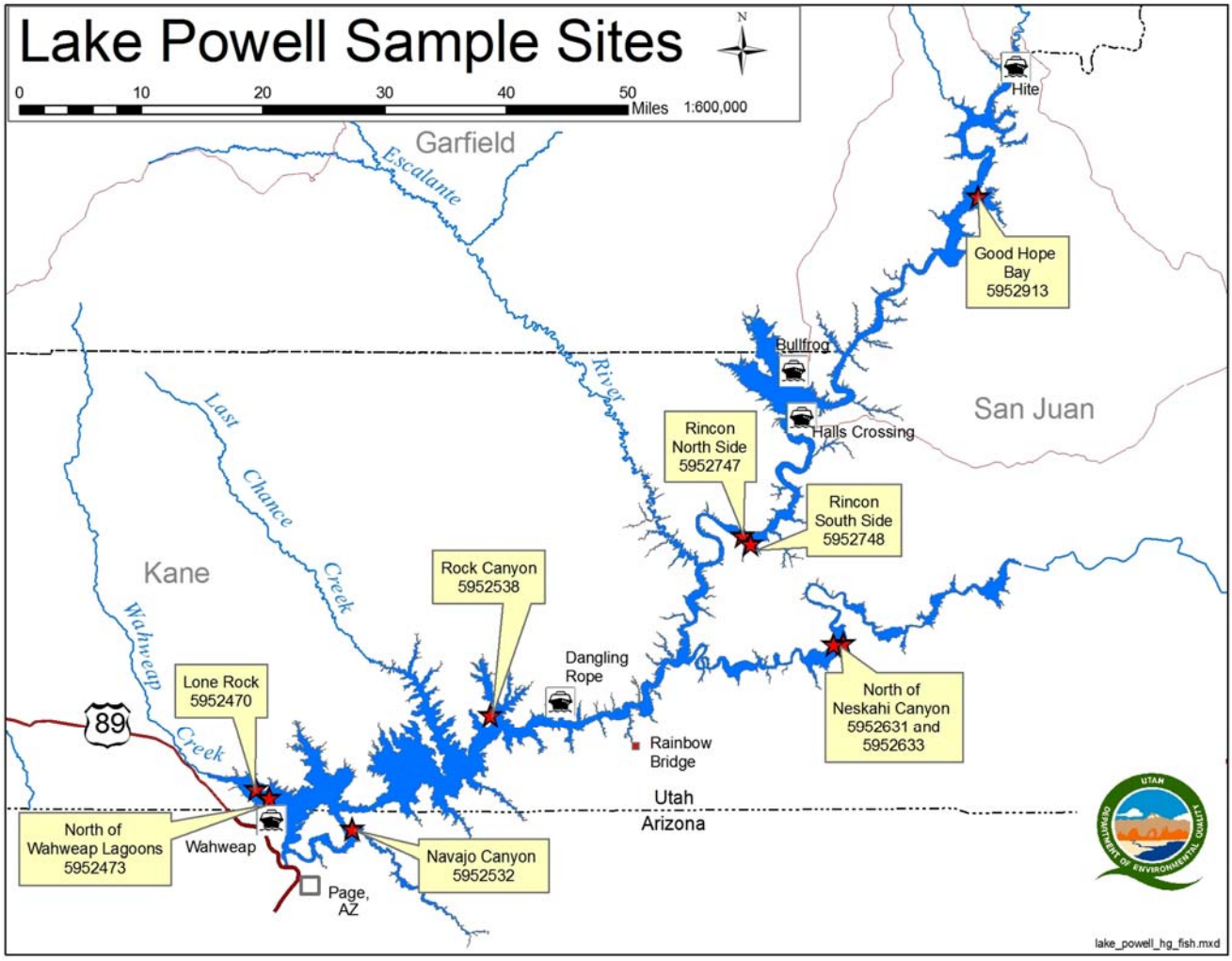
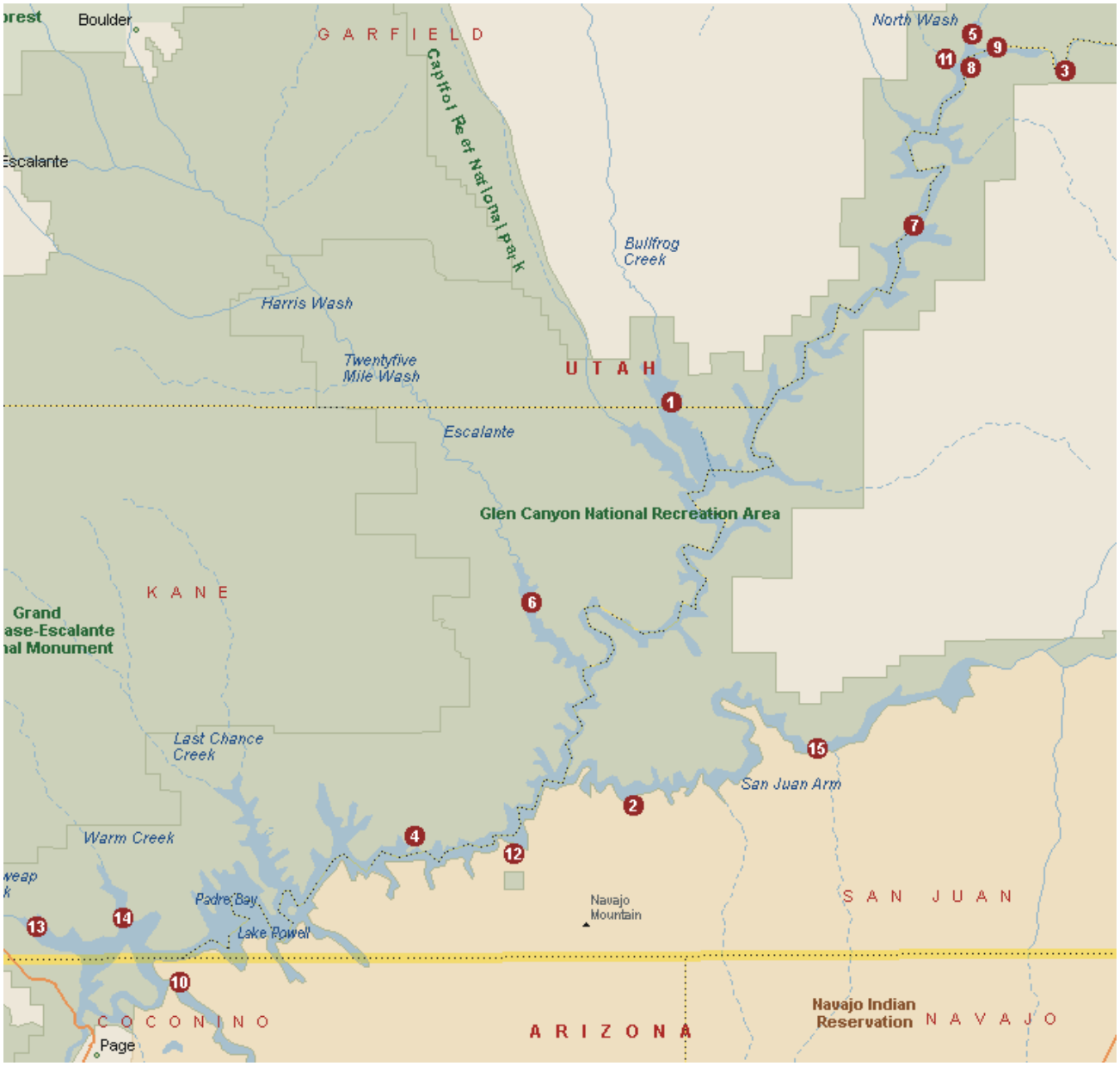


Figure 8. Location of Lake Powell fish sampling sites from 1991-1994.



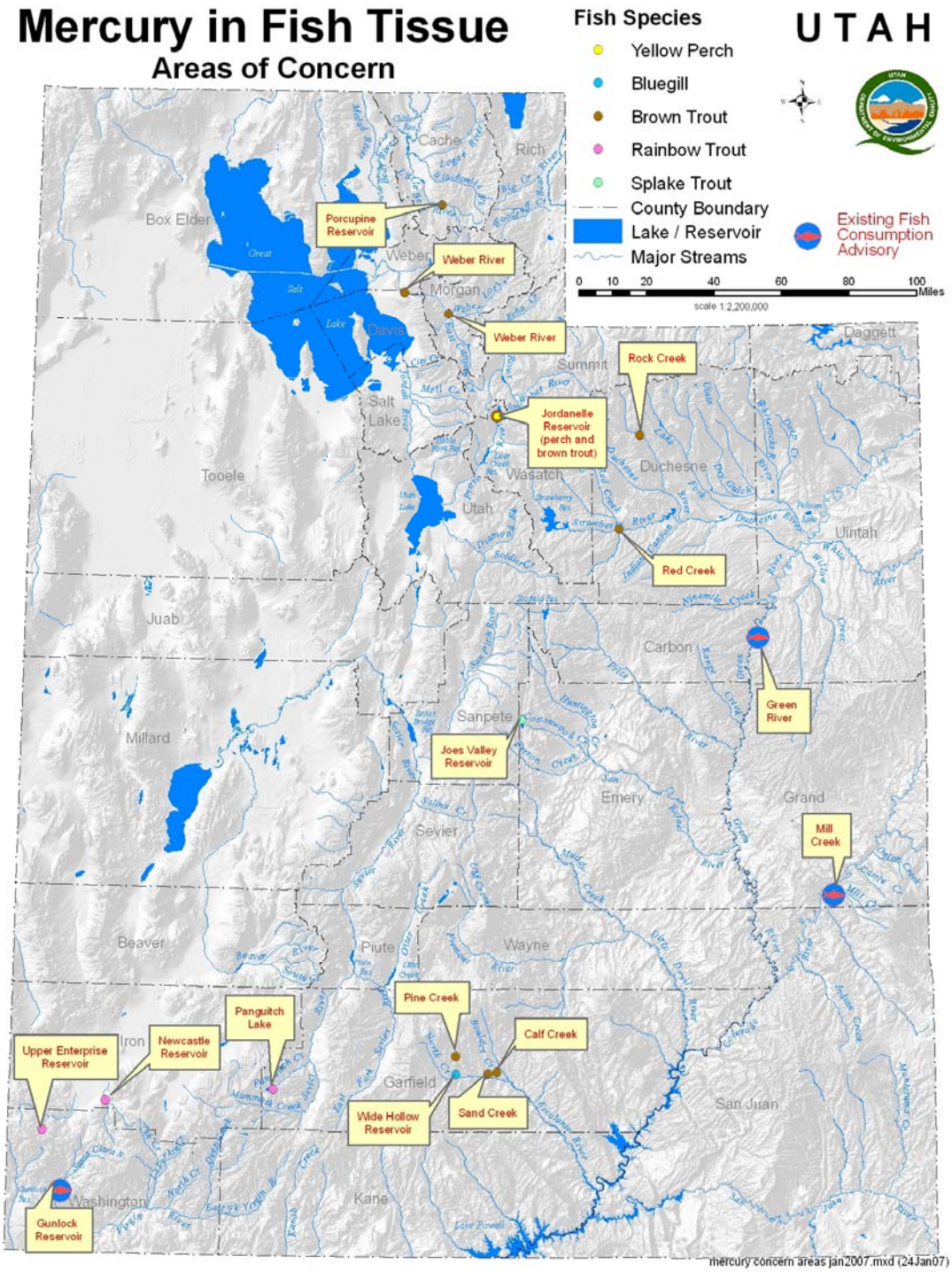
1: Bullfrog Bay
2: Cha Canyon
3: Colorado River
4: Dangling Rope
5: Dirty Devil
6: Escalante Arm
7: Good Hope Bay
8: Hite Marina
9: Narrow Canyon
10: Navajo Canyon
11: North Wash
12: Oak Canyon
13: Wahweap
14: Warm Creek
15: Zahn Bay

Figure 9. Location of fish sampling sites from Lake Powell from 2005.

1: Navajo Canyon, Coconino County, Arizona

2: Rock Canyon, Kane County

Figure 10. Areas of Concern



Appendix B: Tables

Table 1. Summary of Mercury Concentrations in Fish - Beaver County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Minersville Reservoir Midway Uplake	2005	Rainbow Trt	0.242	5	0.203	0.269
Beaver R @ USFS BNDRY	2004	Brown Trout	0.142	3	0.073	0.273
Inat CK 1.5mi ab Beaver R	2004	Brook Trout	0.064	3	0.055	0.074
Lake CK ab Three Creeks Reservoir	2004	Brown Trout	0.246	3 (1)	0.181	0.345
South FK North CK at End of Road	2004	Rainbow Trt	0.053	3	0.038	0.068

Table 2. Summary of Mercury Concentrations in Fish - Cache County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Blacksmith R @ Mouth of Canyon @ U-101 Xing	2005	Brown Trout	0.094	5	0.035	0.227
Cub R @ Casper Ice Cream Rd Xing	2005	Rainbow Trout	0.018	1		
Cub R @ Casper Ice Cream Rd Xing	2005	Black Bullhead	0.062	1		
Cub R @ Casper Ice Cream Rd Xing	2005	Common Carp	0.115	2	0.107	0.123
Davenport CK ab CNFL/ S FK Little Bear R	2005	Cutthroat Trout	0.057	2	0.049	0.065
Davenport CK ab CNFL/ S FK Little Bear R	2005	Brown Trout	0.020	3	0.016	0.022
High CK ab CNFL/ North FK High CK	2004	Brown Trout	0.014	3	0.011	0.016
Logan R W of the Dugway	2004	Cutthroat Trout	0.081	1		
Logan R W of the Dugway	2004	Brown Trout	0.127	3	0.084	0.174
Porcupine Reservoir Near Dam	**2006**	**Brown Trout**	**0.349**	**4 (3)**	**0.255**	**0.431**
Porcupine Reservoir Near Dam	2006	Rainbow Trt	0.366	1 (1)		
Hyrum Reservoir Midlake 02	2006	Rainbow Trt	0.082	5	0.073	0.094
Hyrum Reservoir Near Dam	2006	Rainbow Trt	0.069	3	0.063	0.080
Hyrum Reservoir Near Dam	2006	Brown Trt	0.232	2	0.212	0.251

* Mean mercury concentration is statistically significantly greater than 0.30 mg/kg.
Results in bold have mean values above 0.30 mg/kg.
Numbers in ( ) are number of fish tested that were greater than 0.30 mg/kg.

Table 3. Summary of Mercury Concentrations in Fish - Carbon County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Fish CK ab CNFL/White R	2005	Brown Trout	0.209	5 (1)	0.125	0.430
Price R ab Price R Coal (Braztah, No American)	2005	Tiger Trout	0.041	5	0.028	0.049
Rock CK bl Forks (Green River)	2005	Brown Trout	0.143	5	0.092	0.298
Scofield Res Shore M Bolotas 14A	2006	Cutthroat Trt	0.112	4	0.103	0.123
Scofield Res Shore M Bolotas 14A	2006	Rainbow Trt	0.082	6	0.039	0.118
Scofield Res SW Perry's Boat Camp 04	2006	Cutthroat Trt	0.110	5	0.097	0.150
Scofield Res SW Perry's Boat Camp 04	2006	Rainbow Trt	0.084	4	0.071	0.104

Table 4. Summary of Mercury Concentrations in Fish - Daggett County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Beaver CK ab Browne Reservoir	2005	Brook Trout	0.134	5	0.080	0.212

Table 4. Summary of Mercury Concentrations in Fish - Davis County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Farmington CK 1.5 mi ab Gage	2004	Rainbow Trt	0.053	3	0.041	0.070

Table 5. Summary of Mercury Concentrations in Fish - Duchesne County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Duchesne R bl Gray Mtn Canal	2005	Brown Trout	0.067	5	0.061	0.075
Red CK 1mi ab Strawberry R	**2005**	**Brown Trout**	**0.347**	**5 (3)**	**0.117**	**0.611**
Rock CK bl Bridge @ Miners Gulch Campground	**2005**	**Brown Trout**	**0.380**	**5 (3)**	**0.081**	**0.735**
Rock CK 3mi bl USGS Gage nr Barrow Ponds	2005	Brown Trout	0.098	5	0.067	0.153
Starvation Res nr Knight Diversion Inlet 02	2005	Walleye	0.213	10(3)	0.114	0.404
Strawberry R ab Starvation Reservoir	2005	Brown Trout	0.220	5 (1)	0.123	0.439

* Mean mercury concentration is statistically significantly greater than 0.30 mg/kg.
Results in bold have mean values above 0.30 mg/kg.
Numbers in ( ) are number of fish tested that were greater than 0.30 mg/kg.

Table 5. Summary of Mercury Concentrations in Fish - Duchesne County

Uinta R @ USFS Bndry	2005	Rainbow Trout	0.023	4	0.020	0.028
Uinta R @ USFS Bndry	2005	Brook Trout	0.111	2	0.077	0.144
Lake FK R ab Moon Lake	2004	Brook Trout	0.045	3	0.032	0.063
Lake FK R ab Moon Lake	2004	Cutthroat Trout	0.035	1		
Yellowstone R ab Riverview Campground	2004	Cutthroat Trout	0.143	1		
Yellowstone R ab Riverview Campground	2004	Brook Trout	0.123	2	0.121	0.126

Table 6. Summary of Mercury Concentrations in Fish - Emery County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Huntington Lk N 01	2006	Rainbow Trout	0.059	6	0.022	0.098
Huntington Lk N 01	2006	Brown Trout	0.097	4	0.065	0.140
Joes Valley Res N Arm	2006	Cutthroat Trout	0.207	3	0.173	0.235
Joes Valley Res N Arm	**2006**	**Splake Trout**	**0.824***	**7 (4)**	**0.105**	**1.862**

Table 7. Summary of Mercury Concentrations in Fish - Garfield County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Asay CK .5mi bl US-89 Xing	2005	Brown Trout	0.116	5	0.072	0.177
Asay CK .5mi bl US-89 Xing	2005	Mtn Whitefish	0.108	5	0.067	0.158
Bear CK bl Haws Pasture	2005	Brook Trout	0.058	5	0.048	0.076
Butler CK ab USFS BNDRY	2005	Brown Trout	0.097	5	0.058	0.116
Calf CK ab Campground	**2005**	**Brown Trout**	**0.466***	**5 (5)**	**0.349**	**0.685**
Deer CK @ Burr Trail Xing E of Boulder	2005	Brown Trout	0.268	5	0.208	0.306
E FK Boulder CK ab Kings Pasture	2005	Brook Trout	0.037	5	0.028	0.052

* Mean mercury concentration is statistically significantly greater than 0.30 mg/kg.
Results in bold have mean values above 0.30 mg/kg.
Numbers in ( ) are number of fish tested that were greater than 0.30 mg/kg.

Table 7. Summary of Mercury Concentrations in Fish - Garfield County

Lake CK @ Hells backbone RD Xing	2005	Brook Trout	0.050	5	0.037	0.060
Mamie CK 3 mi ab Escalante River	**2005**	**Brown Trout**	**0.396**	**3 (3)**	**0.326**	**0.519**
Mammoth CK @ Rd Xing on Mammoth CK Rd	2005	Brown Trout	0.134	5	0.080	0.167
Mammoth CK @ US-89 Xing	2005	Brown Trout	0.210	5 (1)	0.055	0.349
North CK ab CNFL/West CK (Escalante)	2005	Brook Trout	0.096	5	0.045	0.156
Panguitch Lake Shore Lakeview	**2005**	**Rainbow Trout**	**0.321**	**6 (2)**	**0.212**	**0.475**
Pine CK bl the Box @ USGS Stn	**2005**	**Brown Trout**	**0.386**	**5 (4)**	**0.202**	**0.558**
Sand CK 2 mi ab Escalante River	**2005**	**Brown Trout**	**0.395**	**5 (2)**	**0.255**	**0.802**
Antimony CK ab Old Gage	2004	Brown Trout	0.159	3 (1)	0.069	0.313
Lower Bowns Reservoir	2006	Rainbow Trout	0.149	5	0.121	0.191
Wide Hollow Reservoir	**2006**	**Bluegill**	**0.315**	**10 (5)**	**0.186**	**0.557**

Table 8. Summary of Mercury Concentrations in Fish - Grand County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Fisher CK ab USFS Bndry	2005	Cutthroat Trout	0.049	5	0.027	0.068
Castle CK ab USFS Rd Xing to Colorado	2004	Brown Trout	0.023	5	0.018	0.029
Negro Bill Canyon ab U-128 Xing	2004	Largemouth Bass	0.141	3	0.074	0.182
South FK Mill CK 1mi ab LaSal Loop RD	2004	Brown Trout	0.044	3	0.032	0.064

* Mean mercury concentration is statistically significantly greater than 0.30 mg/kg.
Results in bold have mean values above 0.30 mg/kg.
Numbers in ( ) are number of fish tested that were greater than 0.30 mg/kg.

Table 9. Summary of Mercury Concentrations in Fish - Iron County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Newcastle Reservoir Above Dam 01	**2006**	**Rainbow Trout**	**0.475***	**5 (5)**	**0.401**	**0.524**

Table 10. Summary of Mercury Concentrations in Fish - Kane County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
East FK Sevier R ab CNFL/ Podunk CK	2005	Brook Trout	0.080	5	0.029	0.220

Table 11. Summary of Mercury Concentrations in Fish - Millard County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Corn CK ab USFS Bndry	2005	Brown Trout	0.055	5	0.039	0.081
North FK South FK Chalk CK (Fillmore)	2005	Brown Trout	0.107	5	0.099	0.115
South FK Chalk CK ab Pistol Rock Picnic Area (Fillmore)	2005	Cutthroat Trout	0.063	5	0.044	0.080
Sevier R @ U-257 Xing in Deseret	2005	Common Carp	0.018	5	0.006	0.027
Sevier R @ U-257 Xing in Deseret	2005	Channel Catfish	0.064	5	0.041	0.101
Sevier R @ U-257 Xing in Deseret	2005	Black Crappie	0.094	5	0.042	0.142

Table 12. Summary of Mercury Concentrations in Fish - Morgan County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
East Canyon CK @ Waldren Property	2005	Brown Trout	0.141	5	0.082	0.195
East Canyon CK @ Waldren Property	2005	Mtn Whitefish	0.210	5	0.147	0.243
Weber R bl Morgan Lagoons	**2005**	**Brown Trout**	**0.443***	**5 (5)**	**0.389**	**0.558**

Table 13. Summary of Mercury Concentrations in Fish - Piute County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Box CK ab Canyon Mouth 1mi W of Greenwich	2005	Brown Trout	0.243	5 (1)	0.135	0.445
Otter CK @ the Narrows	2004	Brown Trout	0.130	3	0.104	0.180

* Mean mercury concentration is statistically significantly greater than 0.30 mg/kg.
Results in bold have mean values above 0.30 mg/kg.
Numbers in ( ) are number of fish tested that were greater than 0.30 mg/kg.

Table 13. Summary of Mercury Concentrations in Fish - Piute County

Pine CK @ Canyon Mouth nr Picnic Area	2004	Rainbow Trout	0.042	3	0.025	0.066
Pine CK bl Bullion Falls	2004	Cutthroat Trout	0.027	3	0.026	0.027
Shingle CK @ the End of the Road	2004	Cutthroat Trout	0.053	2	0.052	0.053
Otter Creek Reservoir Midway Uplake 02	2006	Rainbow Trout	0.126	5	0.090	0.196
Otter Creek Reservoir 1/3 Way Up Lake	2006	Rainbow Trout	0.158	5	0.090	0.241
Piute Reservoir	2006	Rainbow Trout	0.210	10 (1)	0.143	0.310

Table 14. Summary of Mercury Concentrations in Fish - Rich County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Bear Lake Off Cisco Beach	2005	Cutthroat Trout	0.109	5 (1)	0.039	0.334
Bear Lake Off Cisco Beach	2005	Bonneville Whitefish	0.040	5	0.025	0.048
Bear Lake Off State Boat Ramp (West)	2005	Cutthroat Trout	0.076	5	0.049	0.149
Bear Lake Off State Boat Ramp (West)	2005	Bonneville Whitefish	0.044	5	0.030	0.056
Bear Lake Off State Boat Ramp (West)	2005	Lake Trout	0.039	2	0.037	0.041

Table 15. Summary of Mercury Concentrations in Fish - Salt Lake County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Big Cottonwood CK 3/4mi ab Mill A	2004	Brown Trout	0.051	3	0.040	0.071

Table 16. Summary of Mercury Concentrations in Fish - San Juan County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Geyser CK Trans Diversion @ Redd Ranch Rd Xing	2005	Cutthroat Trout	0.082	5	0.055	0.103
Kens Lake	2005	Largemouth Bass	0.256	10 (2)	0.152	0.366

* Mean mercury concentration is statistically significantly greater than 0.30 mg/kg.
Results in bold have mean values above 0.30 mg/kg.
Numbers in ( ) are number of fish tested that were greater than 0.30 mg/kg.

Table 16. Summary of Mercury Concentrations in Fish - San Juan County

Kens Lake 001 ab Dam	2005	Rainbow Trout	0.129	5	0.088	0.150
Kens Lake Upper End 002	2005	Brown Trout	0.207	2	0.175	0.238
Kens Lake Upper End 002	2005	Rainbow Trout	0.121	5	0.083	0.153
Lake Powell @ Good Hope Bay 1/4 mi S of Castle…	2005	Smallmouth Bass	0.105	5	0.062	0.178
Lake Powell @ Good Hope Bay 1/4 mi S of Castle…	2005	Striped Bass	0.090	10	0.053	0.122
Lake Powell @ Rincon (Northside)	2005	Smallmouth Bass	0.064	5	0.057	0.073
Lake Powell @ Rincon (Southside)	2005	Striped Bass	0.088	10	0.069	0.133
Lake Powell 1 mi N of old Waheap Lagoons	2005	Smallmouth Bass	0.196	4	0.167	0.220
Lake Powell 200 M E of Lone Rock	2005	Striped Bass	0.280	10 (5)	0.134	0.369
Lake Powell-San Juan Arm N of Neskahi Canyon	2005	Channel Catfish	0.112	4	0.076	0.196
Lake Powell-San Juan Arm N of Neskahi Canyon	2005	Striped Bass	0.169	10	0.123	0.226
Lake Powell-San Juan Arm N of Neskahi Canyon	2005	Smallmouth Bass	0.155	5	0.112	0.213
LaSal CK 1mi ab Colorado border	2005	Rainbow Trout	0.032	2	0.026	0.038
LaSal CK ab Fish Barrier	2005	Brook Trout	0.047	5	0.039	0.055
Johnson CK ab CNFL/ Red Bluff CK	2004	Brook Trout	0.019	3	0.018	0.020

Table 17. Summary of Mercury Concentrations in Fish -Sanpete County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Gooseberry CK bl Fairview Lakes	2005	Cutthroat Trout	0.160	3	0.108	0.201
Manti CK bl USFS Campground	2005	Rainbow Trout	0.088	5	0.080	0.103

* Mean mercury concentration is statistically significantly greater than 0.30 mg/kg.
Results in bold have mean values above 0.30 mg/kg.
Numbers in ( ) are number of fish tested that were greater than 0.30 mg/kg.

Table 17. Summary of Mercury Concentrations in Fish -Sanpete County

San Pitch R 2.5mi W of Mt Pleasant ab Restoration Project	2005	Brown Trout	0.165	5	0.099	0.250
San Pitch R ab Fairview WWTP	2005	Brown Trout	0.046	5	0.038	0.061
Twelvemile CK bl Pinchot Campground	2005	Cutthroat Trout	0.099	5	0.082	0.125

Table 18. Summary of Mercury Concentrations in Fish -Sevier County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Salina CK @ Accord LK Exit	2005	Brown Trout	0.294	4 (1)	0.122	0.509
Salina CK @ Accord LK Exit	2005	Cutthroat Trt	0.285	4 (1)	0.186	0.407
Clear CK bl CNFL/ Fish CK	2004	Brown Trout	0.088	3	0.072	0.110
Sevier R ab CNFL/ Clear CK @ US-89 Xing	**2004**	**Brown Trout**	**0.328**	**3 (1)**	**0.187**	**0.502**

Table 19. Summary of Mercury Concentrations in Fish -Summit County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Bear R @ UT/WY State Line	2005	Cutthroat Trt	0.076	5	0.051	0.103
Bear R @ UT/WY State Line	2005	Brook Trout	0.098	5	0.062	0.128
Beaver CK ab Crooked CK	2005	Brown Trout	0.150	5 (1)	0.046	0.365
Blacks FK R ab Meeks Cabin Reservoir	2005	Brook Trout	0.095	2	0.063	0.127
Blacks FK R ab Meeks Cabin Reservoir	2005	Cutthroat Trt	0.094	3	0.073	0.115
Blacks FK R ab Meeks Cabin Reservoir	2005	Mtn Whitefish	0.143	1		
Provo R ab Woodland 1mi ab USGS Gage	2005	Brown Trout	0.220	5 (1)	0.125	0.349
Provo R ab Woodland 1mi ab USGS Gage	2005	Mtn Whitefish	0.075	5	0.052	0.101
Sawmill CK 2.5mi ab Echo CK	2005	Cutthroat Trt	0.043	5	0.030	0.067

* Mean mercury concentration is statistically significantly greater than 0.30 mg/kg.
Results in bold have mean values above 0.30 mg/kg.
Numbers in ( ) are number of fish tested that were greater than 0.30 mg/kg.

Table 19. Summary of Mercury Concentrations in Fish -Summit County

West FK Beaver CK @ Upper USFS Rd Xing	2005	Brook Trout	0.082	5	0.057	0.143
Weber R @ Hoytsville	2005	Brown Trout	0.201	5	0.087	0.296
Weber R @ Hoytsville	2005	Common Carp	0.294	5 (3)	0.179	0.396
Weber R ab Rockport Reservoir	2005	Brown Trout	0.091	5	0.051	0.168
Weber R bl Henefer Lagoons	2005	Brown Trout	0.192	5	0.112	0.265
Weber R bl Henefer Lagoons	2005	Mtn Whitefish	0.110	5	0.098	0.132

Table 20. Summary of Mercury Concentrations in Fish -Tooele County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Clover CK 30m bl Spring	2005	Brown Trout	0.021	5	0.012	0.028
South Willow CK @ L Narrows	2005	Rainbow Trout	0.033	5	0.025	0.041

Table 21. Summary of Mercury Concentrations in Fish -Uinta County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Ashley CK ab Dry FK CK	2005	Brown Trout	0.104	5	0.035	0.228
Big Brush CK @ Hwy 44 Xing	2005	Rainbow Trout	0.063	5	0.032	0.142
Carter CK @ Hwy 44 Xing	2005	Brook Trout	0.191	5 (1)	0.092	0.435
Carter CK @ Hwy 44 Xing	2005	Rainbow Trout	0.184	5	0.128	0.241
Green R nr Ouray @ U88 Xing	2005	Channel Catfish	0.245	10 (3)	0.100	0.374
North FK Ashley CK @ Red Cloud Loop RD	2005	Rainbow Trout	0.032	5	0.011	0.100
Whiterocks R @ Old USGS Gage	2004	Brook Trout	0.089	3	0.069	0.125

* Mean mercury concentration is statistically significantly greater than 0.30 mg/kg.
Results in bold have mean values above 0.30 mg/kg.
Numbers in ( ) are number of fish tested that were greater than 0.30 mg/kg.

Table 22. Summary of Mercury Concentrations in Fish -Utah County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Bennion CK ab LDS Property	2005	Cutthroat Trout	0.028	5	0.023	0.036
Clear CK an CNFL/ Soldier CK 3/4mi ab Rest Area	2005	Cutthroat Trout	0.037	3	0.028	0.045
Diamond FK CK ab 6th Water	2005	Brown Trout	0.136	5	0.104	0.186
Soldier CK bl CNFL/Tie FK	2005	Brown Trout	0.160	5	0.074	0.287
Utah Lake 1mi W of Provo Boat Harbor	2005	White Bass	0.017	5	0.014	0.022
Utah Lake 1mi W of Provo Boat Harbor	2005	Walleye	0.015	1		
Utah Lake 1mi W of Provo Boat Harbor	2005	Black Bullhead	0.043	5	0.026	0.066
Utah Lake 1mi W of Provo Boat Harbor	2005	Channel Catfish	0.020	1		
Utah Lake 1mi W of Provo Boat Harbor	2005	Black Crappie	0.012	1		

Table 23. Summary of Mercury Concentrations in Fish -Wasatch County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Deer Creek Reservoir At West Shore 1/3 MI NE of Dam	2006	Rainbow Trt	0.050	5	0.033	0.071
Deer Creek Reservoir At West Shore 1/3 MI NE of Dam	2006	Brown Trout	0.078	5	0.014	0.130
Deer Creek Reservoir At Wallsburg Bay Midway	2006	Walleye	0.254	5 (2)	0.158	0.344
Deer Creek Reservoir South of Rainbow Bay	2006	Rainbow Trt	0.055	5	0.035	0.093
Jordanelle Reservoir West of Boat Ramp	2006	Rainbow Trout	0.097	5	0.076	0.126
Jordanelle Reservoir West of Boat Ramp	**2006**	**Brown Trout**	**0.562***	**5 (4)**	**0.263**	**0.805**
Jordanelle Reservoir West of Boat Ramp	**2006**	**Yellow Perch**	**0.307**	**5 (2)**	**0.193**	**0.483**

* Mean mercury concentration is statistically significantly greater than 0.30 mg/kg.
Results in bold have mean values above 0.30 mg/kg.
Numbers in ( ) are number of fish tested that were greater than 0.30 mg/kg.

Table 23. Summary of Mercury Concentrations in Fish -Wasatch County

Jordanelle Reservoir Near West Shore Near Old	2006	Rainbow Trout	0.097	5	0.046	0.151
Jordanelle Reservoir Near West Shore Near Old	2006	Brown Trout	0.266	5 (1)	0.143	0.541
Little Deer CK ab CNFL/Provo R	2005	Brown Trout	0.069	5	0.041	0.114
Right FK Currant CK .5mi ab USFS Rd ab CNFL/ Currant CK	2005	Cutthroat Trout	0.064	5	0.036	0.076
Strawberry Reservoir 3/4 up Strawberry Bay	2005	Kokanee	0.080	5	0.076	0.086
Strawberry Reservoir 3/4 up Strawberry Bay	2005	Utah Sucker	0.131	2	0.124	0.137
Strawberry Reservoir 3/4 up Strawberry Bay	2005	Cutthroat Trout	0.174	6 (1)	0.145	0.305

Table 24. Summary of Mercury Concentrations in Fish -Washington County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Beaver Dam Wash ab Motoqua	2005	Mtn Sucker	0.185	5 (1)	0.122	0.329
Pinto CK 2.5mi bl Pinto Town	2005	Rainbow Trout	0.078	5	0.060	0.121
East FK Virgin R @ Shunesburg	2004	Mtn Sucker	0.215	3	0.202	0.232
Middle FK Santa Clara R ab Campground	2004	Brook Trout	0.065	3	0.059	0.072
Upper Enterprise Reservoir Above Dam 01	**2006**	**Rainbow Trout**	**0.655***	**5 (5)**	**0.551**	**0.746**

Table 25. Summary of Mercury Concentrations in Fish -Wayne County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
Fremont River	2005	Brown Trout	0.050	10 (1)	0.031	0.308

Table 26. Summary of Mercury Concentrations in Fish -Weber County

Sites	Sampled	Species	Mean (mg/kg)	N	Min	Max
South FK Ogden R @ Magpie Campground	2005	Brown Trout	0.120	5	0.085	0.168

* Mean mercury concentration is statistically significantly greater than 0.30 mg/kg.
Results in bold have mean values above 0.30 mg/kg.
Numbers in ( ) are number of fish tested that were greater than 0.30 mg/kg.

Table 26. Summary of Mercury Concentrations in Fish -Weber County

Weber R bl US-191	2005	Rainbow Trout	0.060	5	0.029	0.077
Weber R bl US-191	**2005**	**Brown Trout**	**0.333**	**4 (2)**	**0.230**	**0.454**
Willard Bay Res 100m W of S Marina Harbor Mouth 01	2005	Walleye	0.035	1		
Willard Bay Res 100m W of S Marina Harbor Mouth 01	2005	Wiper	0.108	5	0.082	0.128
Willard Bay Res 100m W of S Marina Harbor Mouth 01	2005	Channel Catfish	0.051	5	0.034	0.078
Willard Bay Res in SW Corner .25mi from Shore 02	2005	Walleye	0.026	3	0.022	0.028
Willard Bay Res Midway Along NW Dike 100m Offshore 03	2005	Walleye	0.050	5	0.023	0.102
Willard Bay Res Midway Along NW Dike 100m Offshore 03	2005	Wiper	0.168	5	0.131	0.243
Willard Bay Res Midway Along NW Dike 100m Offshore 03	2005	Channel Catfish	0.074	5	0.035	0.176
Causey Reservoir In Skull Crack Arm	2006	Kokanee	0.229	3	0.219	0.237
Causey Reservoir In Skull Crack Arm	2006	Tiger Trout	0.118	1		
Causey Reservoir In Skull Crack Arm	2006	Splake Trout	0.281	1		
Causey Reservoir North Arm Off Cuasey Estates	2006	Kokanee	0.225	5	0.204	0.239

* Mean mercury concentration is statistically significantly greater than 0.30 mg/kg.
Results in bold have mean values above 0.30 mg/kg.
Numbers in ( ) are number of fish tested that were greater than 0.30 mg/kg.

Appendix C: Consumption Limit Calculations

Consumption Limit Calculations

Consumption Rate Calculations for Noncarcinogenic Health Effects

To calculate the maximum allowable fish consumption rate for a non-carcinogen:

$CR_{lim} = [(RfD)(BW)]/C_m$

Where:

CR_{lim} = maximum allowable fish consumption rate (kg/day)
RfD = 0.0001 mg/kg/day
BW = mean body weight of the general population or sub-population of concern (kg)
C_m = measured concentration of chemical contaminant in a given species of fish (mg/kg)

$CR_{mm} = [(CR_{lim})(T_{ap})]/MS$

Where:

CR_{mm} = maximum allowable fish consumption rate (meals/month)
CR_{lim} = as calculated above
T_{ap} = time averaging period (365.25 days/12 months = 30.44 days per month)
MS = meal size (0.227 kg fish/meal for adults, 0.113 kg fish/meal for children)

Assumptions for Consumption Rate Calculations are as follows:
An average adult weighs 70 kg and eats 227 g (8 ounces) of fish per meal.
An average child weights 16 kg and eats 113 g (4 ounces) of fish per meal.